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Western Mining in the Twentieth Century
Oral History Series

Vincent D. Perry

A HALF CENTURY AS MINING AND EXPLORATION
GEOLOGIST WITH THE ANACONDA COMPANY

With an Introduction by
William A. Humphrey

Interviews Conducted by
Eleanor Swent
in 1990

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VINCENT DENIS PERRY

An Appreciation by John P. Hunt

Vincent Denis Perry, whose half-century career with Anaconda took him from the underground mines of Butte to the board room in New York City, died peacefully in his sleep on Aug. 1, 1997 at his home in Westhampton Beach, NY. He is survived by his daughter and



PERRY

son-in-law, Pat and Walt Zielinski; four grandchildren and seven great-grandchildren.

He graduated from the University of California-Berkeley in 1922 with a B.S. in mining engineering. After graduation, he took a job as an engineer and mine surveyor at the Carson Hill Gold Mines on the Mother Lode. In 1924, he received an M.A. in mining geology from Columbia University.

Following a Journal Club presentation by Reno Sales, Perry interviewed with Sales and accepted a job in Butte, MT with Anaconda Copper Co. This association with Anaconda was destined to last until its liquidation by Atlantic Richfield nearly 50 years later.

Perry entered the Butte geological department in 1924 and was given regular underground beats mapping the Diamond, Mt. View and Mt. Con Mines. There, he learned the systematic and practical Anaconda system for mapping. He also learned the use of geology in operations, a method developed by Sales and Horace Winchell in the early 1900s. While at Butte, Perry also participated in the last major apex litigation — the Elm Orlu/Badger case. It was won by Anaconda on the strength of sound geologic mapping by Sales and other geologists who demonstrated the post-mineral nature of a key fault offsetting the lode.

These were also years of international expansion for Anaconda.

Fifteen percent copper assays were being reported from the recently discovered La Colorada orebody in Cananea. In 1927, Sales sent Perry there to map and evaluate their importance and to set up a Butte-style geological department and system. These expansions proved to be vital for Anaconda. During the depression, profits from Chuquicamata and Cananea saved Anaconda from bankruptcy.

Perry's meticulous mapping of the Colorada orebody at Cananea described the classic goblet form of this zoned, high-grade breccia, perched on the apex of a mineralized porphyry stock and lying 1,000 feet beneath a telltale ring of mall quark veinlets. His mapping and interpretation of the evolution of the Colorada orebody remains one of the best documented cases of the genetic relations between magmas and ore-forming processes. These ideas were later summarized in his paper, *The Significance of Mineralized Breccia Pipes*. In 1961, he was awarded the Jackling Medal by the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME). The paper was the basis of his acceptance lecture.

In 1937, after nearly 10 years working at Cananea and in exploration for gold and base metals in Sonora, Perry was transferred back to the United States to head up western US exploration for Anaconda. He was made chief geologist of the International Smelting and Refining Co., an Anaconda subsidiary, in 1944. Upon Sales' retirement in 1949, Perry became chief geologist of Anaconda. He was to remain Anaconda's chief geologist for 20 years. He was given the additional title of vice president in 1957.

During the 1940s and 1950s, major new copper mines were discovered and brought into production at Yerington, NV and El Salvador, Chile. Perry's role in both of these discoveries was similar and

critical. On early field trips, he recognized the significance of mineralized outcrops at these prospects. He then assigned competent men to map and test the prospects — Bob Moehlman and Alex McDonald to Yerington and Bill Swayne to El Salvador.

Also during the 1940s, Perry sent Jack Knaebel and Glenn Waterman to explore for gold in Omai and other areas of British Guyana and Brazil. In the 1950s, Perry's team explored a large area of Santa Fe Railroad and Laguna Indian Reservation lands in New Mexico for uranium. The Haystack Butte, Jackpile and Paquate orebodies were found, developed and mined. They provided much needed income for Anaconda during periods of low copper prices.

In 1956, Perry was transferred to Anaconda's head office in New York, NY to integrate operations and geological work. He was named vice president in 1957. He served as director and member of the executive committee from 1966 until his retirement in 1970. He also served as a consultant to Anaconda until 1975, completing a half cen-

(Continued on page 96)

NECROLOGY

date elected	name city, state
1996	Donald W. Bobzien Janesville, WI
1954	John H. Davis, Jr. Douglas, AZ
1977	Gene A. Gilbertson Ishpeming, MI
1951	Robert M. Haldeman Santiago, Chile
1963	Russell E. Hoar Casa Grande, AZ
1946	C. Maxwell Norman ** New Smyrna Beach, FL
1966	C. Phillips Purdy Jr. Laurier, WA
1936	A.J. Terrones L ** Mexico DF, Mexico Ventura, CA
1977	Freddy E. Turner Bluefield, WV

** Legion of Honor

(Continued from page 95)

tury of active, loyal service.

During Perry's term as chief geologist and vice president in Salt Lake and New York, he expanded Anaconda's worldwide exploration activities, especially in Chile, Canada and Australia. A large number of significant properties were acquired, tested and, in some cases, put into production. These included Britannia Beach, BC, Caribou, NB and Red Ross, Australia. Unfortunately, the full potential of many of these and other properties was not realized by Anaconda due to the chain of destructive events initiated by the expropriation of Anaconda's properties in Chile in 1971 — the year after Perry's retirement.

Perry also expanded the concept of integrating geological research work into active mining operations and exploration. This concept had been initiated in the 1940s by Reno Sales. Perry was awarded an honorary Doctor of Science degree by the University of Montana in 1965 and an Engineering

Achievement award in 1970 by AIME.

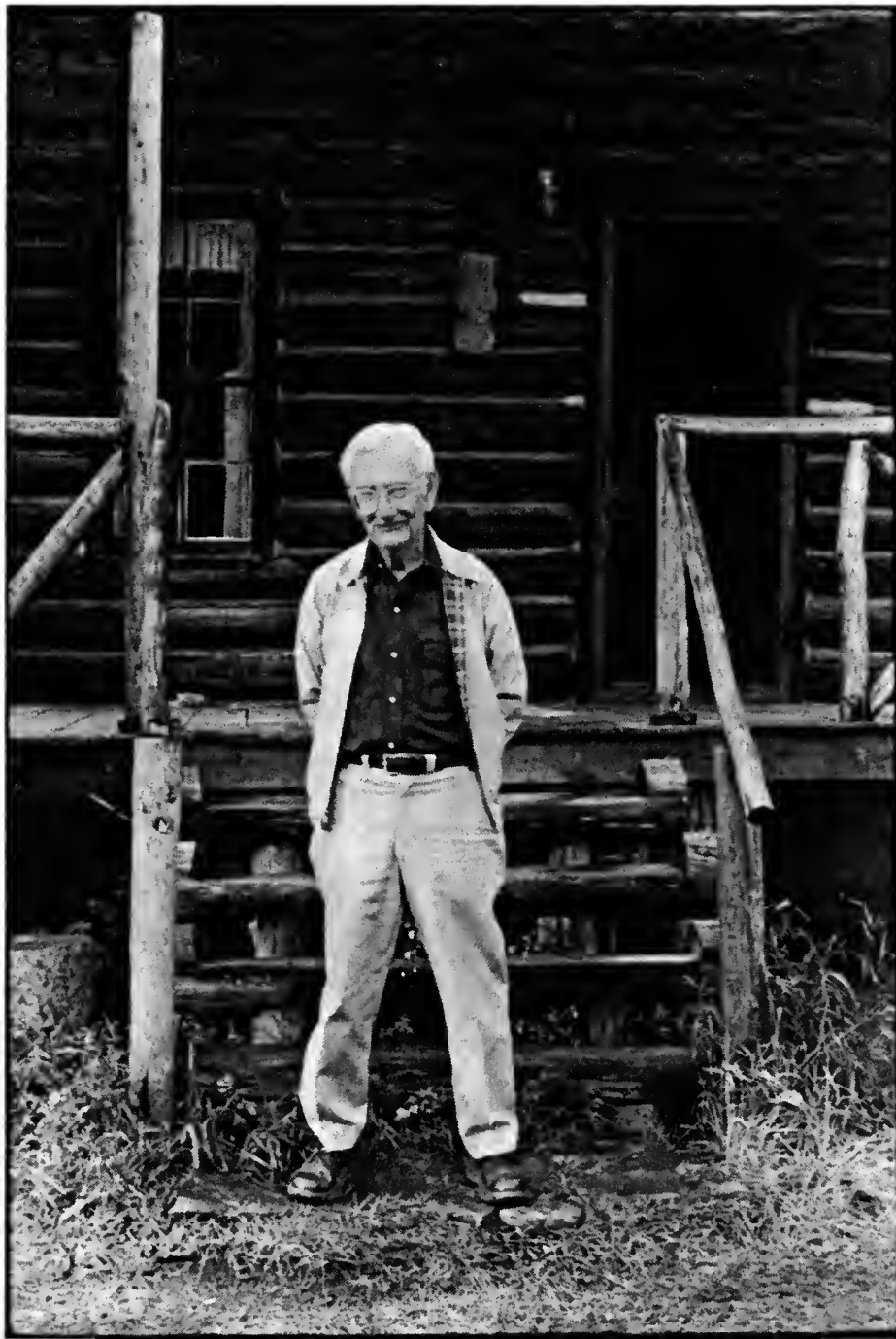
He was a quiet and very courteous gentleman who delighted in his wife's rambunctious, fun-loving and, at times, irreverent Irish wit. She also accompanied him on many of his inspection trips. She provided the perfect complement and backup for his travels and social occasions throughout their long marriage. Margaret also was a good mining-camp wife during their days together at Butte and Cananea.

Perry's memory of outcrops and his geological observations from all over the world was nothing short of amazing. At the age of ninety he could tell you what he had seen in the state vein of the Mt. Con Mine in 1926, what he saw on top of Indio Muerto in 1944, at Red Ross in 1968 and, of course, on any level of La Colorada.

During the last decade of his life, he focused his geologic thoughts on the remaining exploration potential of the Butte District.

He usually visited the Montana Geological Resources department during his annual fishing trips on the Gallatin River. He believed that there was more copper to be found in Butte than has been produced to date.

Vin Perry was an inspiration to his professional associates and large family alike. He was a geologist's chief geologist. He was a mentor to scores of geologists of all ages and, to some, an ever-youthful geological father. ■



VINCENT D. PERRY
Covered Wagon Ranch, Gallatin River, Montana
1987

Cataloging Information

Perry, Vincent (b. 1901)

Geologist

A Half Century as Mining and Exploration Geologist with the Anaconda Company,
xiii, 128 pp., 1991.

San Francisco earthquake and fire, 1906; education: University of California College of Mining, Columbia University; Argonaut Mine fire, 1922; mine geologist for Anaconda Co., Butte, Montana, 1924-1928; chief geologist, Cananea, Mexico, 1928-1937; chief geologist, Anaconda Co., Salt Lake City, 1937-1956; explorations: Mountain City Copper (Nevada), Yerington (Nevada), Twin Buttes (Arizona), Grants District (New Mexico), Chile, British Guyana, Brazil; vice president, director, Anaconda Co., 1965-1969; comments on ore resources, geologic methods, management practices, liquidation of Anaconda Co.

Introduction by William Humphrey, executive vice president, Homestake Mining Company.

Interviewed in 1990 by Eleanor Swent for Western Mining in the Twentieth Century series. The Regional Oral History Office, The Bancroft Library, University of California, Berkeley.

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PREFACE

The oral history series on Western Mining in the Twentieth Century documents the lives of leaders in mining, metallurgy, geology, education in the earth and materials sciences, mining law, and the pertinent government bodies. The field includes metal, non-metal, and industrial minerals, but not petroleum.

Mining has changed greatly in this century: in the technology and technical education; in the organization of corporations; in the perception of the national strategic importance of minerals; in the labor movement; and in consideration of health and environmental effects of mining.

The idea of an oral history series to document these developments in twentieth century mining had been on the drawing board of the Regional Oral History Office for more than twenty years. The project finally got underway on January 25, 1986, when Mrs. Willa Baum, Mr. and Mrs. Philip Bradley, Professor and Mrs. Douglas Fuerstenau, Mr. and Mrs. Clifford Heimbucher, Mrs. Donald McLaughlin, and Mr. and Mrs. Langan Swent met at the Swent home to plan the project, and Professor Fuerstenau agreed to serve as Principal Investigator.

An advisory committee was selected which included representatives from the materials science and mineral engineering faculty and a professor of history of science at the University of California at Berkeley; a professor emeritus of history from the California Institute of Technology; and executives of mining companies.

We note with much regret the death of two members of the original advisory committee, both of whom were very much interested in the project. Rodman Paul, Professor Emeritus of History, California Institute of Technology, sent a hand-written note of encouragement just a few weeks before his death from cancer. Charles Meyer, Professor Emeritus of Geology, University of California at Berkeley, was not only an advisor but was also on the list of people to be interviewed, because of the significance of his recognition of the importance of plate tectonics in the genesis of copper deposits. His death in 1987 ended both roles.

Thanks are due to other members of the advisory committee who have helped in selecting interviewees, suggesting research topics, and raising funds.

Unfortunately, by the time the project was organized several of the original list of interviewees were no longer available and others were in failing health; therefore, arrangements for interviews were begun even without established funding.

The project was presented to the San Francisco section of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) on "Old-timers Night," March 10, 1986, when Philip Read Bradley, Jr. was the speaker. This section and the Southern California section provided initial funding and organizational sponsorship.

The Northern and Southern California sections of the Woman's Auxiliary to the AIME (WAAIME), the California Mining Association, and the Mining and Metallurgical Society of America (MMSA) were early supporters. Several alumni of the University of California College of Engineering donated in response to a letter from Professor James Evans, the chairman of the Department of Materials Science and Mineral Engineering. Other individual and corporate donors are listed in the volumes. The project is ongoing, and funds continue to be sought.

Some members of the AIME, WAAIME, and MMSA have been particularly helpful: Ray Beebe, Katherine Bradley, Henry Colen, Ward Downey, David Huggins, John Kiely, Noel Kirshenbaum, and Cole McFarland.

The first five interviewees were all born in 1904 or earlier. Horace Albright, mining lawyer and president of United States Potash Company, was ninety-six years old when interviewed. Although brief, this interview will add another dimension to the many publications about a man known primarily as a conservationist.

James Boyd was director of the industry division of the military government of Germany after World War II, director of the U.S. Bureau of Mines, dean of the Colorado School of Mines, vice president of Kennecott Copper Corporation, president of Copper Range, and executive director of the National Commission on Materials Policy. He had reviewed the transcript of his lengthy oral history just before his death in November, 1987. In 1990, he was inducted into the National Mining Hall of Fame, Leadville, Colorado.

Philip Bradley, Jr., mining engineer, was a member of the California Mining Board for thirty-two years, most of them as chairman. He also founded the parent organization of the California Mining Association, as well as the Western Governors Mining Advisory Council. His uncle, Frederick Worthen Bradley, who figures in the oral history, was in the first group inducted into the National Mining Hall of Fame, Leadville, Colorado, in 1988.

Frank McQuiston, metallurgist, vice president of Newmont Mining Corporation, died before his oral history was complete; thirteen hours of taped interviews with him were supplemented by three hours with his friend and associate, Robert Shoemaker.

Gordon Oakeshott, geologist, was president of the National Association of Geology Teachers and chief of the California Division of Mines and Geology.

These oral histories establish the framework for the series; subsequent oral histories amplify the basic themes.

Future researchers will turn to these oral histories to learn how decisions were made which led to changes in mining engineering education, corporate structures, and technology, as well as public policy regarding minerals. In addition, the interviews stimulate the deposit, by interviewees and others, of a number of documents, photographs, memoirs, and other materials related to twentieth century mining in the West. This collection is being added to The Bancroft Library's extensive holdings.

The Regional Oral History Office is under the direction of Willa Baum, division head, and under the administrative direction of The Bancroft Library.

Interviews were conducted by Malca Chall and Eleanor Swent.

Willa K. Baum, Division Head
Regional Oral History Office

Eleanor Swent, Project Director
Western Mining in the Twentieth
Century Series

October 1990
Regional Oral History Office
University of California, Berkeley

Western Mining in the Twentieth Century Oral History Series
Interviews Completed or in Process, January 1991

- Horace Albright, Mining Lawyer and Executive, U.S. Potash Company, U.S. Borax, 1933-1962, 1989
- James Boyd, Minerals and Critical Materials Management: Military and Government Administrator and Mining Executive, 1941-1987, 1988
- Philip Read Bradley, Jr., A Mining Engineer in Alaska, Canada, the Western United States, Latin America, and Southeast Asia, 1988
- Catherine C. Campbell, Ian and Catherine Campbell, Geologists: Teaching, Government Service, Editing, 1989
- James T. Curry, Sr., Metallurgist for Empire Star Mine and Newmont Exploration, 1932-1955; Plant Manager for Calaveras Cement Company, 1956-1975, 1990
- Helen R. Henshaw, Recollections of Life with Paul Henshaw: Latin America, Homestake Mining Company, 1988
- Lewis L. Huelsdonk, Manager of Gold and Chrome Mines, Spokesman for Gold Mining, 1935-1974, 1988
- Arthur I. Johnson, Mining and Metallurgical Engineer in the Black Hills: Pegmatites and Rare Minerals, 1922 to the 1990s, 1990
- Evan Just, Geologist: Engineering and Mining Journal, Marshall Plan, Cyprus Mines Corporation, and Stanford University, 1922-1980, 1989
- Plato Malozemoff, A Life in Mining: Siberia to Chairman of Newmont Mining Corporation, 1909-1985, 1990
- Frank Woods McQuiston, Jr., Metallurgist for Newmont Mining Corporation and U.S. Atomic Energy Commission, 1934-1982, 1989
- Gordon B. Oakeshott, The California Division of Mines and Geology, 1948-1974, 1988
- Vincent D. Perry, A Half Century as Mining and Exploration Geologist with the Anaconda Company, 1991
- Samuel S. Arentz, Jr. (Escalante Mine), in process
- Donald Dickey (Oriental Mine), in process
- H. S. Pete Fowler (Kaiser)
- James M. Gerstley (U.S. Borax), in process
- George Heikes (tungsten, zinc), in process
- John Livermore (geologist), in process
- Carl Randolph (U.S. Borax), in process
- John Reed (rock mechanics)
- Joseph Rosenblatt (EIMCO), in process
- Eugene Smith (U.S. Borax), in process
- Langan Swent (San Luis, Homestake, uranium mining), in process
- James V. Thompson (Kaiser Engineers), in process

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INTRODUCTION--by William A. Humphrey

Forty-one years ago when I graduated from the University of Arizona College of Mines, the mining industry was in one of its cyclical slumps. Definitely a bad time for a young mining graduate with a wife and child to be looking for a job. As luck would have it, I was able to wangle an appointment for an interview with the Anaconda Company, headquartered in New York City.

The interview, set for 2 p.m. on a pleasant day in May, was to take place in the renowned Pioneer Hotel in downtown Tucson, Arizona. I was to meet a high-ranking official, Mr. Vincent D. Perry, chief geologist, and one of his assistants, Mr. Alex McDonald. Nervous? You bet I was!

We sat in the lobby of that fine old hotel where I was told about the "goings-on" in the Anaconda Company. Toward the end of the meeting, that lasted about half an hour, Vin asked me, "Why is it you think you want to come and work in the geological department?"

My rather immature answer was, "First, because I need to make a living for my wife and child and second, because I think mining and geology are romantic ways to do it."

Vin responded by saying with a twinkle in his eye, "I agree on both counts." Alex McDonald, rough and crusty old miner that he was, commented, "Yes, kid, but that romance can sure get to be a big pain in the --- after a while!"

I thought, "Oh boy! No job for me." But again Vin intervened with a chuckle and I realized right then that this man, who I was in awe of, also had a sense of humor and, more importantly, was sensitive to my feelings and so probably to other people's as well. I later learned that indeed this was the case. Vin didn't push the people working for him so much as he inspired them. I'll tell you, it sure made a young scared kid feel good that day.

Subsequently I did get the job in the geological department of an Anaconda subsidiary, the Cananea Consolidated Copper Company, located in Cananea, Sonora, Mexico. As a result I was to see more of Vin Perry as time went on.

After graduating with an engineering degree from the College of Mining, University of California, in 1922, Vin started out by working as a "mucker" in the Melones Mine at Angels Camp, California. He then went back to school for his master's degree at Columbia in 1924, and shortly thereafter to his first managerial position as chief geologist at the Cananea operations. From then on there was no stopping Vin Perry. By the time of my employment as a junior engineer at Cananea, Vin was already approaching the apex of his career. Named vice president of the Anaconda Company in 1956, he went on to be designated the 1961 recipient of the coveted AIME Jackling Award that each year is presented to a person for significant contributions to technical progress in mining, geology, and geophysics. This was followed by an honorary doctor of science degree from the Montana School of Mines in 1965 and then his election as a director of the Anaconda Company the following year. These are only a few of the milestones that track a very impressive professional career.

In the 1950s and 1960s Vin would usually visit Cananea about twice a year to check on our progress, make suggestions, and give direction. This was always done in a way that was encouraging and positive and always moved us to try harder. Occasionally he would bring his delightful wife, Margaret, along so during the after-work and evening functions we were able to enjoy her sociability, wit, and fun-loving attitude that seemed to be contagious. These people certainly made good role models for youngsters like my wife and me. On looking back, although I have no first-hand knowledge, I know it was most probably Margaret that kept Vin from taking himself too seriously. A good combination and a fine couple.

Some years later, even though I was still a long way down the corporate ladder, Vin had time for the personal touch. I remember when my mother died I received one of the warmest supportive letters that anyone could wish for. It was only a one-page handwritten note, but I can still recall the message that was sympathetic while at the same time urged me to look forward to closer binding ties to my own young family.

Early in my career my interest turned to operations rather than exploration, and as a result my contacts with Vin became less frequent, but we still have kept in touch and see each other occasionally over the years as our professional paths cross.

In the entire forty-one years I have known him, I have never known Vin to be anything but "up-beat."

I think Vin Perry, the man, is best epitomized by the refrain from a popular song circa 1950s that he often quoted: "You gotta accentuate the positive, eliminate the negative, latch on to the affirmative, and don't mess with Mr. In-between."

William A. Humphrey
Executive Vice President
Homestake Mining Company

February 22, 1991
San Francisco

INTERVIEW HISTORY--Vincent Perry

Vincent Perry's half-century career as mining and exploration geologist, chief geologist, vice president, and director of the Anaconda Company included significant geological analysis at Cananea in Mexico and discovery of the Salvador Mine in Chile. His name was proposed early in the planning of the oral history series on Western Mining in the Twentieth Century, but it was lamented that this career could probably not be documented because he was advanced in years and living in New York, and project funds could not cover travel expenses. The Anaconda Company, for which he worked nearly all his life, was now defunct, so we could not turn there for funding.

In the fall of 1989, however, word was received through a friend of the oral history project that Mr. Perry was still in vigorous health and planning to spend several weeks in Carmel, California. Correspondence began, and the invitation letter was sent to Mr. Perry on 23 February 1990.

Interviews were conducted on March 7, 8, 9, and 13, 1990, at the Carmel Mission Inn. Mr. Perry proved to be a delightful interviewee who prepared well for the sessions and whose memory appeared undimmed. He spoke easily of his full and happy life and successful career. He had made his hotel suite into a home office; on the dresser were photos of his late wife, Margaret, and on the desk were geological maps and working papers.

The tapes were transcribed, lightly edited, and the transcript sent to him in June and July, 1990. He made extensive revisions, adding substantive material which will be welcomed by scholars. A gentleman of the old school, he also revised much of the informal diction. The document is valuable in recording his outstanding career, even though some of the ease and humor of his conversation has been edited out.

He vividly recollects the San Francisco earthquake and fire, and his student years at the Mining College of the University of California, where he graduated in 1922. He tells of his experience, as a junior mining engineer at Carson Hill, working on the rescue team after the Argonaut Mine fire, which took a toll of forty-seven lives. Then he went to Columbia University for his master's degree in geology, which led to his work assisting legendary Anaconda geologist Reno Sales. He recalls

Butte, Montana, still in its heyday; and Cananea, Mexico, in good times as well as during a revolutionary period. These recollections will be of interest to researchers in many fields other than the history of the minerals industry.

He discusses in detail his theories of ore genesis and their application to La Colorada ore body at Cananea, Mexico, and the Butte, Montana, district. He describes the discovery and development of the important ore bodies at El Salvador, Chile, and Yerington, Nevada. He is a perceptive observer of the technical and management practices which led to the eminence of Anaconda in the mining world, as well as some of the decisions which led to its downfall.

Several people gave valuable help in the completion of this oral history. William Humphrey, executive vice president of Homestake Mining Company, who was associated with Mr. Perry for many years at Anaconda, contributed the gracious introduction and personal tribute. Plato Malozemoff, advisor to the Western Mining series, served as our New York City representative in encouraging Mr. Perry in the tedious task of reviewing the manuscript. Ms. Eve Cleary-McDermott assisted with typing in New York. The completed volume was presented to Mr. Perry at the annual banquet of the University of California Mining Association, 19 April 1991.

The tapes of the interviews are deposited at The Bancroft Library, University of California at Berkeley.

Eleanor Swent, Interviewer-Editor
Western Mining in the Twentieth

Century Series

15 March 1991
Regional Oral History Office
486 The Bancroft Library
University of California at Berkeley

BIOGRAPHICAL INFORMATION

(Please write clearly. Use black ink.)

Your full name Vincent D. Perry
Date of birth November 26 1901 Birthplace San Francisco, California
Father's full name Antonio Perry
Occupation Wool business Birthplace San Pablo, Contra Costa Co., C
Mother's full name Sarah A. Perry
Occupation School teacher-housewife Birthplace San Francisco, California
Your spouse Margaret Moore Perry
Your children Patricia Perry Zielinski

Where did you grow up? San Francisco; Mill Valley, Marin Co.; Berkeley.
Present community New York City and Westhampton Beach, N.
Education B.S. Mining Engineering 1922 Univ. of California Berkeley
M.S. Mining Geology 1924 - Columbia Univ. New York
Occupation(s) Mining Geologist

Areas of expertise Mining Geology

Other interests or activities

Organizations in which you are active

VINCENT DENIS PERRY



1088 Park Ave New York, NY 10128.
P.O. Box 615

Westhampton Beach, New York 11978

Born: San Francisco, Cal. Nov. 26, 1901

University of California at Berkeley.

B.S. Mining Engineering 1922

Columbia University, New York

M.S. Mining Geology 1924

Member Tau Beta Pi (honorary eng. fraternity) Univ. of Calif.

Member Theta Tau - Epsilon Chapter University of California

Member Sigma Xi (honorary scientific fraternity) Columbia Univ.

Married Margaret Moore - Butte, Montana - November 16, 1926

Daughter, Mary Patricia - b. Inspiration, Ariz. March '8, 1928

Grandchildren Mark, Anne, Jean, Carol Zielinski of New York City

Assistant Engineer Carson Hill Gold Mines, Inc., California

June 1922-September 1923

Mining Geologist, Anaconda Co., Butte, Mont. June 1924-Apr. 1928

Chief Geologist, Cananea Con. Copper Co., Mexico, April 1928-

July 1937

Exploration Geologist, Anaconda Co., Southwest U.S.A. July 1937-

September 1939

Exploration Geologist, Anaconda Co., Salt Lake City, Utah

September 1939-January 1944

Chief Geologist, Int. Smelting and Ref. Co., Salt Lake City

January 1944-January 1945

Assistant Chief Geologist, Anaconda Co., Salt Lake City

January 1945-January 1948

Chief Geologist, Anaconda Co., Salt Lake City, January 1948-

December 1956

Vice President and Chief Geologist, Anaconda Co., New York

January 1957-December 1969

Director and Member Executive Com., Anaconda Co., New York

May 1966-May 1970

Geological Consultant, Anaconda Co., New York Jan. 1970-Dec. 1971

Geological Consultant, Underground Mine Study of Butte for

Anaconda, January 1974-December 1975

Jackling Award Am. Inst. Min. Eng. February 1961

Honorary Degree Univ. of Montana-Doctor of Science-June 1965

Engineering Achievement Award Am. Int. Min. Eng. February 1970

Legion of Honor Am. Int. Min. Eng. February 1974

Distinguished Member Am. Inst. Min. Eng. October 1975

~~E~~-Member Alta Club, Salt Lake City; Am. Int. Min. Eng.; Min. and

Met. Soc. of Am.; Society of Economic Geologists; Geological

Society of America; Mining Club, New York

Author of various Technical Publications

I EARLY YEARS

[Interview 1: March 7, 1990]##*

Family

Swent: Mr. Perry, do you want to tell a little bit about your family and your early years in San Francisco?

Perry: I was fortunate to arrive at the start of the twentieth century, and to have had the opportunity to live through this great, action-packed period in our history for most of that century. I was born in San Francisco, California, November 26, 1901, of devoted parents, whose ancestors went back to the Gold Rush days. My father's brother was married to my mother's sister so there was a close relationship that made my aunt and uncle really second parents to our family. They had no children so we provided a family for them.

They lived next door to us on Sacramento Street, just below Leavenworth. We were a closely-knit family group, and I was the oldest child. My sister Eleanor followed me, and then a brother, Frank, and finally my younger sister, Mary, who arrived just six weeks before that terrible date, April 18, 1906, when San Francisco suffered the devastation of the earthquake and succeeding fire.

The San Francisco Earthquake of 1906

Swent: Do you recall the earthquake at all?

*This symbol (##) indicates the start of a new tape or tape segment. For a guide to the tapes, see page 124.

Perry: It is my earliest childhood memory. I was in my own bedroom and was awakened by the smashing of a large picture of the Madonna against the wall, and of my mother rushing in to douse a little kerosene lamp that I had by my bedside. My dad early that morning put me on his shoulders and carried me to our roof garden where we could look out over a large part of San Francisco, particularly the section extending southwesterly along Market Street to Twin Peaks. And there the sight of the entire city in flames was an awesome one, indeed. I suppose my dad and my uncle, too, began early efforts to try and get us out of our homes and to some place of safety. They found a lot of cooperation in the help of soldiers, members of the United States Army, who had been assigned to the disaster areas from their headquarters in the Presidio to restore order and protect against looting. They also provided water, food and shelter for people that had suffered complete loss of home and essential services.

My dad had a business in downtown San Francisco, and he left almost immediately for his office, where he arrived just ahead of the advancing flames, entered his vault, and recovered all his essential papers, including the insurance policies that covered our properties. He started back up the Sacramento Street hill past the Fairmont Hotel, and the weight of the books was almost too much for him. At that time he was accosted by a lone Chinaman who said, "Me help you." This good man assisted my dad up to Jones Street at the top of Nob Hill, and there my dad took over the burden again. He reached into his pocket and handed the Chinaman a one-ounce \$20 gold piece. The Chinaman said, "Me no take your money. Me likee Americans." Which my father thought was a wonderful thing to happen, and it shows what people do, particularly under times of stress, and in this case, an Oriental who was simply being a good Samaritan in his adopted land.

We waited out the first two days of the fire, watching it creep towards us from different directions. It was a terrifying time, and I know my folks were attempting to get together some sort of organization so that an escape would be possible. My dad had many friends in San Francisco, and on the morning of the third day he showed up with a horse and wagon. I don't know where he found them or who let him have them, but at any rate, he loaded that wagon with the things that my mother wanted to save, clothes and some supplies.

We started out that morning with me perched on the wagon beside my dad; my uncle, aunt, and mother on foot beside us pushing the baby buggy with my brother Frank and my tiny baby sister, Mary, in the buggy; and Eleanor, who was about three years old then, trotting alongside them. We went northerly towards, I believe, Pacific Avenue. I suppose the direction was generally obtained

from army personnel who were doing everything to try and help the movement of refugees away from the fire area. Most people went out to the Presidio, where tents had been set up, and soup kitchens provided for feeding thousands of people. My dad decided he wanted to head eastward across the Bay to Alameda County. We went east on Pacific Avenue, and apparently the army had cleared the street of enough rubble and debris so we could get through. We skirted beyond the firefront which was advancing northerly in that area. My one vivid memory is looking down those cross streets through literally tunnels formed by the towering flames that reached several hundred feet in the air and crested in huge explosive flares.

We reached the Embarcadero and moved south to the Ferry Building. I doubt that we were able to get the horse and wagon on the ferryboat, and we probably lost some of our luggage, although I have no clear memory of that. At least we did get across to Oakland and down to Centerville in Alameda County, where my dad's parents had a farm. We finally arrived there late that night, and with great relief and thanksgiving we had our first normal night's sleep.

Swent: Where is Centerville?

Perry: Centerville is now part of the city of Fremont. At that time it was wide-open farm country with a farmhouse every half-mile or so. It was beautiful country, and I remember it so well because it was my first experience away from the streets and sidewalks of San Francisco. I remember going out that next morning and seeing this tremendous fig tree, something that I had no real concept of until that moment. It was a tree that had a spread of over a hundred feet, its branches held up by wood supports, and it must have been planted in the very early days when my grandparents located or bought the farm. The land was close to Alameda Creek and well watered. It was excellent farming country.

After the first few nights of sleep and rest and recovery, my folks found a place in San Leandro where they rented a house, and we settled there temporarily until we could get back to the reconstruction job in San Francisco. My parents went back and forth to the city, and within a very short period--I would judge it wasn't more than a month or two--they were able to collect the insurance from Fireman's Fund Insurance Company so that they could start rebuilding. The first two structures that were put up were portable houses on Kimball Place, which is a small, side street off Sacramento close to Leavenworth. My parents and my aunt and uncle moved there in 1907 while plans were made to rebuild their houses. The construction was started on them immediately so that we moved

into our new homes in a very short time, probably the spring of 1908, although I am not sure of the exact date.

Swent: You might tell about the insurance.

Perry: Payment of insurance was a remarkable operation, done under difficult conditions, and with very little in the nature of office facilities. The Fireman's Fund Insurance Company, which carried the insurance on our homes, had the financial resources and also the will and the spirit to meet punctually its full financial obligations. The company set up an outdoor office on Market Street, and people stood in line out in the street, waiting their turn and with their papers in hand. As they approached the desk, papers were expeditiously checked. If the papers were in order, the insurance was paid out with minimum red tape. I remember that line and holding my mother's hand, as we waited patiently for our turn. My parents apparently had no difficulty in recovering the insurance on our properties in San Francisco and this, of course, greatly facilitated the early rebuilding of our homes, my parents' and my aunt's and uncle's.

Swent: Times have changed.

Perry: Yes, this was done in a period when there was no government agency to facilitate such rehabilitation. But the United States government certainly did help through the judicious use of its army services. I think the army deserves a great deal of credit for the emergency control it established and the early recovery that was made in San Francisco. The Presidio was a main military establishment, and it lived up to all its obligations and duties. I think that was a very impressive contribution.

Swent: So you started school, then, back in San Francisco.

Perry: I started school almost immediately after we moved into our new home. It was the Redding Public School in San Francisco. Within a year, my dad decided that it was not the healthiest thing in the world to raise four children in the city. So, in that summer of 1909, shortly after I'd started school, we moved to Mill Valley in Marin County and rented our place in San Francisco to the Kress family, who were good friends of ours. The Kresses owned and operated a high-quality furniture store at the corner of, I believe, Stockton and Sutter--at least in the general Union Square shopping area. They were wonderful tenants and my parents were fortunate to have them. We went ahead and bought a place in Mill Valley and I proceeded with my schooling there, and my sisters and brother followed me. We all attended Tamalpais High School, and when I finished high school the question was, "What do we do about the university?" My dad decided that he wanted to keep the family

together, so we sold our home in Mill Valley and bought a place in Berkeley on Virginia Street just south of Euclid.

The University of California College of Mining. Class of 1922

Perry: My first six months at Berkeley, while the sale of the property was proceeding, was spent alone on the campus, and I, of course, wanted to join a fraternity. My dad didn't think too much of that idea. He was in the wool business--and had some close contacts with the Koshlands and others in the Jewish community in San Francisco. He said, "There's a Mrs. Breslau, a widow who lives near the North Gate of the Berkeley campus. I've arranged to have you room and board with her." [laughter] It was not particularly pleasing to me, but in retrospect, I look back and think that it did me a world of good, because it just happened that there were three or four Jewish boys that were freshmen with me and stayed at the Breslau home. They were marvelous students, and they taught me how to use the library and how to study. I am eternally grateful for that experience; otherwise I might not have gotten off to a really good scholastic start at Berkeley.

Swent: What were their names?

Perry: Heller and Hellman are names I remember. There were others, and they became very prominent in San Francisco business affairs. I can't recall their names now, but I remember Heller very well because he was most helpful to me. He was a history major, and told me about Henry Morse Stephens and the wonderful history courses he was giving. So despite the fact that I had decided by then that I wanted to be a mining engineer, Heller talked me into taking two courses with Henry Morse Stephens: one, "War Issues," and the other, "Peace Issues," which were so appropriate to that time when World War I had just ended. Stephens was a noted historian and a great speaker, and I learned a lot in those two courses. They were helpful to me in my life afterwards, even though they had no direct relation to engineering.

Swent: So if you were taking an engineering degree, you were not required to take any liberal arts courses?

Perry: Practically none; the engineering courses at the University of California at that time were fully packed with required engineering subjects, including math, physics, and chemistry with limited electives. I made a point of trying to take electives because I felt that I needed at least a minimum of broadening in addition to all of the science courses that were heaped upon me. I tried to do

that through my four years, but it was a difficult thing to do because of the very strict scholastic requirements of the College of Mining. They had a particularly difficult curriculum because it included mechanical engineering, electrical engineering, civil engineering, and geology, in addition to the required mining and metallurgical courses.

Frank Probert was dean of the College of Mining, and I developed a very great respect and admiration for him. He gave several mining courses, and was assisted by a fine staff, including Professors Weeks, Uren and Morley. There were others on the staff whose names I don't recall at the moment.

My interest in geology was primary because I liked the subject and wanted to follow in the exploration branch of mining. But I realized that to be competent in the search for new mines you had to understand the elements that are essential in constructing a successful mining operation. I enjoyed the engineering courses and they supplemented the ones I took in the Geology Department under Professors Lawson, Louderback, Taliaferro, and Eakle, the mineralogist. They were all excellent teachers. Louderback was particularly effective with his students in the field. He'd take us out every weekend, sometimes just through the Berkeley Hills, but also on long trips into the Sierras and to various mining districts where we had a chance to see and map mine-related geology. He insisted on our making careful and accurate maps, taught us how to pace long distances, locate ourselves by triangulation and Brunton compass, and measure with accuracy the things that we observed. He was a great observer himself, and stressed the importance of observation in any kind of geological investigation.

Swent: Did you do a lot of mapping?

Perry: We did a lot of mapping, and that was a wonderful opportunity to learn how to do these things in the field, not just to study textbooks and learn the theory of geology. The training at Berkeley emphasized field experience and the obtaining of factual data. It was the kind of training that I found in later years to be most beneficial in doing geological and exploration work.

Swent: And this was not true at all universities at that time, was it?

Perry: Well, I'm not sure. Later, when I took my graduate work at Columbia, I found that there was more emphasis at Columbia on the theoretical side of geology, although we did go on several field trips in New Jersey and upstate New York. I think that the bigger, first-class schools that specialized in geological training or

mining geology generally followed the primary axiom of learning how to do field work and how to put the observed facts on paper so that you had a basis for reasonable analysis of what you were looking at and what this meant.

##

Swent: Let's go back just a bit. How did you happen to get interested in studying mining at all?

Perry: My dad wanted me to go into the wool business with him. He had a plant in San Francisco that bought, washed and graded raw wool. It was called the Western Wool and Warehouse Company. I worked there two summers, and after seeing the general nature of the work, it had little appeal for me.

Swent: How old were you when you first worked there? Do you remember?

Perry: It was, I believe, at the start of my sophomore year in high school. About that same time, we had a neighbor in Mill Valley by the name of Herbert Lang. Lang had a son who was about my age, and we were good friends. The father was a mining engineering graduate from the University of California who had worked in Montana and been successful enough to acquire an attractive home in Mill Valley, who had retired at a fairly young age, and had become a consulting mining engineer. He took great delight in showing his son how to sink shafts, build model headframes, et cetera. I became part of that boyhood coalition, and our greatest achievement was the sinking of a fourteen-foot deep shaft, timbered and equipped with hoisting windlass, in the backyard of the Lang home. My first summer after entering Berkeley, he gave his son and me jobs in a mine he was opening up at Round Mountain, Nevada. After the summer job experience in Nevada, I decided that despite my father's desires, I was not going to go into the wool business; I was going to concentrate my studies on becoming a mining engineer.

Swent: What did you do in the summer up in Round Mountain? Were you actually working?

Perry: Yes, we worked. My brother joined Herb Lang and me, and at first we worked on the graveyard shift tending the flumes. It was an hydraulic operation using giant monitors to wash down the gold-bearing gravel. Water was brought from the Toiyabe Mountains across the valley and into Round Mountain, and the gravel was washed from the alluvial deposits that flanked the west side of the mineralized core of the Round Mountain district. It was a great experience; I learned a lot. The mine foremen were good at moving us into a variety of jobs such as how to drill holes in the large boulders that were left after the hydraulic washing process, and

how to load those holes and ignite the charges, and then run for cover. It was a lot of fun for us youngsters. We learned quite a bit about some of the fundamentals of mining at that time.

Swent: They would never let you do that today, would they?

Perry: [laughter] Probably not, no. We were child labor, I guess. But it was a great experience, and we were fortunate to escape without any injury or problems. We learned to take care of ourselves.

Swent: Where did you live?

Perry: We lived at a little hotel in Round Mountain that had a dining room. We had a comfortable life.

Swent: You were completely on your own? No parents there?

Perry: Oh, no. No, we were completely on our own.

Swent: That's interesting. So when you started the university, you already had some experience in mining.

Perry: Well, I'd had the exposure to Mr. Lang's mining influence and, by contrast, had two summers working at my father's wool warehouse in San Francisco. Then my summer's mining experience at Round Mountain, Nevada, convinced me more than ever that I wanted to go into the mining profession. I found that at that time, the College of Mining at Berkeley had students that were oriented in a similar way. They were students that came either from mining families or at least from mining communities.

Swent: It was a very popular department at that time.

Perry: Yes, it was a popular department. It was a small department; there weren't many students, but I would judge there were perhaps fifteen or twenty in my graduating class. Two of my close friends, Larry Morel and Abe Yates, had just finished their thesis on the Homestake Mine. When Engineering Day came along in our senior year, we served together on a committee to organize the program. We set up a stamp mill in the Hearst Memorial Mining Building, with a crusher and a Hardinge mill. We had amalgamating plates, Wilfley tables, and a full-going milling operation for the visitors.

All of the mining students participated in this sort of thing. They liked to operate, they like to be part of a going concern, even though it was a miniature scale and on a university campus. But the spirit of mining was everywhere there in the college.

Incidentally, we had two members of the California Wonder Team of 1921 and '22 in that group--Dan McMillan and Jimmy Dean--who were out at football practice part of the time and yet were required to carry the same scholastic load that all the rest of us did, and they did very well. I was a great admirer of both those men. They were star football players, and yet they were able to maintain high scholastic grades as mining engineering students.

We were very proud of that Cal Wonder Team because those were the days when Cal was undefeated. In fact, I never attended a football game during my four years at Berkeley that Cal didn't win. [laughs] One of the most exciting trips I had was when a group of us got together the last day of 1920, and drove down the coast in a rickety old Franklin auto to Pasadena to see Cal beat Ohio State 28 to 0 at the Rose Bowl. [laughs] So, those were some of the joys of being at Berkeley then, besides all of the gratification we got out of our scholastic work.

Swent: Could you go to Los Angeles in one day?

Perry: No, it took us two days. Two long, hard days. We left early in the morning from Berkeley and arrived at San Luis Obispo about eleven o'clock that night. I remember going over the San Juan grade coming into Salinas, and wondering whether we were ever going to make it. [laughs] Leaving San Luis Obispo at dawn, we arrived in Los Angeles just in time for the game.

Teachers at Cal

Swent: You didn't mention Professor Joel Hildebrand.

Perry: Hildebrand was one of our fine teachers in the Chemistry Department. He was extremely popular. We'd be in the lab carrying on experiments in chemistry, and, even though we were being supervised closely by instructors, Hildebrand would always be there looking down our necks to see that everything went right, and never being too serious, usually coming up with some light remark or a pat on the back if things didn't go exactly as planned. But he was always an inspiration, and his famous display at Big Game time when he was able to show all kinds of college colors by performing chemical experiments on his lecture bench, was a delightful diversity to all his students. [laughter]

Swent: You also liked Lawson, you said.

Perry: I liked Andy Lawson because he was also a professor that stressed the humorous side of life and science. His famous remark, which I suppose was oft-repeated, about the terrible grumbling down in the bowels of the earth accompanying volcanic eruptions, always fascinated the class. He had many wise comments and he was a very able lecturer.

Swent: You felt that you got good, practical academic training?

Perry: I felt that the courses given at Berkeley were outstanding. I came away fulfilled in the sense that the people who had instructed us sounded as though they knew what they were talking about. They were men that had had a good deal of experience, and they spoke with conviction. I think they made a great impression on the students. I was very glad that I had had the opportunity to go to Cal and to enjoy that kind of contact. It was something that has been with me through all my professional life, and I am sure that the training I received was as good or better than anything that was available anywhere else. I say that advisedly, because after I had worked a year on the Mother Lode at the Carson Hill Gold Mines, I went to Columbia to do graduate work in geology.

Swent: How did you happen to choose Columbia?

Perry: I chose Columbia because I had an opportunity to meet Professor Robert Raymond, then Dean of Mining at Columbia, who was carrying on an investigation of the Carson Hill Gold Mines for a client. My job was to take him underground and generally be his helper and guide during the examination. He told me that he felt that it would be worthwhile for me to broaden my education by doing some graduate work at Columbia. His suggestions were so appealing to me that I decided that this was something that would be well worth doing. I had saved enough money from my work at Carson Hill so that I could afford the trip back East and the then very modest financial requirements of a year at Columbia University, besides living in the City of New York. [laughs]

Working At Carson Hill: The Argonaut Mine Fire

Swent: How did you get the job at Carson Hill? Let me go back. Did you work summers, there, also?

Perry: Well, I worked one summer at Carson Hill. Then as graduation approached I thought that it would be important for me to find a job in a different place. I didn't want to just stay in the State

of California; I wanted to get out and see the rest of the world. So, first of all, I had an offer from the testing laboratories of Anaconda, at Anaconda, Montana. They were looking for testing engineers, and I had tentatively decided on going up there when I received word that because of the end of World War I and the drop in the price of copper, their testing and research activities were being curtailed. So that job was closed.

Swent: When did you graduate?

Perry: I was graduated in 1922. Dean Probert told me he had heard of a job opening in mining geology at Cerro de Pasco in Peru. Don McLaughlin was then chief geologist of Cerro de Pasco and was in Berkeley on a vacation. Probert arranged an interview with McLaughlin, who gave me some encouragement and said that he would discuss my application with Dr. L. C. Graton at Harvard University, who was in overall control of the geological work of Cerro de Pasco at that time. Two weeks later a letter came back saying that Hugh McKinstry had been accepted as a geologist at Cerro de Pasco for the job I had expected to get. So that was closed.

My final opportunity was to go back to Carson Hill where I had worked the summer before, and I found that they were anxious to get me back on their payroll. I had worked before as a miner, and they made me an engineer. I also worked as a surveyor and in the safety department for the next year.

However, we experienced a calamitous event. The Argonaut Mine at Jackson had a disastrous fire. I was a member of the safety crew at Carson Hill and we were ordered out in the middle of the night to drive over to Jackson, about thirty-five miles northwest, to help in attempts to rescue miners trapped in the Argonaut. Forty-seven men were cut off from escape on the 4200 level. The main incline shaft was down-cast and the auxiliary vertical Muldoon shaft was up-cast, with fans sucking the air down the incline and through the mine workings where the men were trapped. The fire was burning in the main incline shaft, heavily supported with wooden timbers which provided readily ignitable fuel.

When the fire was thought to be controllable it was being fought by going down the main incline shaft with fresh air at the back of the fire fighters. At some critical stage the fire got out of control but the management persisted in fighting it through the incline and shut down but did not reverse the Muldoon shaft fan so the miners on the 4200 level were trapped by an ever-increasing flow of toxic gas and smoke.

The Bureau of Mines rescue group arrived the next morning from Berkeley, and the bureau chief decided that the only way to effect the rescue was to drive an incline raise from the adjoining Fremont Mine to connect with the Argonaut. It took three long weeks to drive the connection and when we finally got through the raise and into the Argonaut Mine, we found forty-six bodies piled up at the end of a crosscut. It was a terrible job to recover all those bodies and to haul them out of the mine through that narrow little raise up to the surface. The forty-seventh body was found later in another part of the mine. It was a tragedy that left a real imprint on me. I wondered whether mining was going to be as much fun as I had expected it was going to be.

Swent: Did you think that the decision not to reverse the fan was correct?

Perry: Timing was vital. The fan should not have been reversed as long as the fire was controllable. The Bureau of Mines agreed that the management was correct in not reversing the fan. But to me it looked as though they should have decided at some stage that the fire was uncontrollable and let the shaft burn out so that the men would have a chance to get out instead of facing all the gas and smoke that was being circulated through the Muldoon fan. That's something that I've wondered about, whether the decision was the right one or not. It's like many things that happen where a decision has to be made in a short period of time, and the decision, in my judgment, may have been wrong.

Swent: But you were actually with the crew then that was doing the emergency raise?

Perry: I wasn't a member of the crew that drove the raise; I was one of the group that entered the Argonaut Mine through the raise connection with the Fremont Mine and recovered the miners' bodies.

##

Perry: I have a photograph taken at the face of the crosscut by the Bureau of Mines that reads, "Gas getting strong. 3 A.M. Fessell." It was written with the smoke of a carbide lamp. Fessell apparently was the leader of the men.

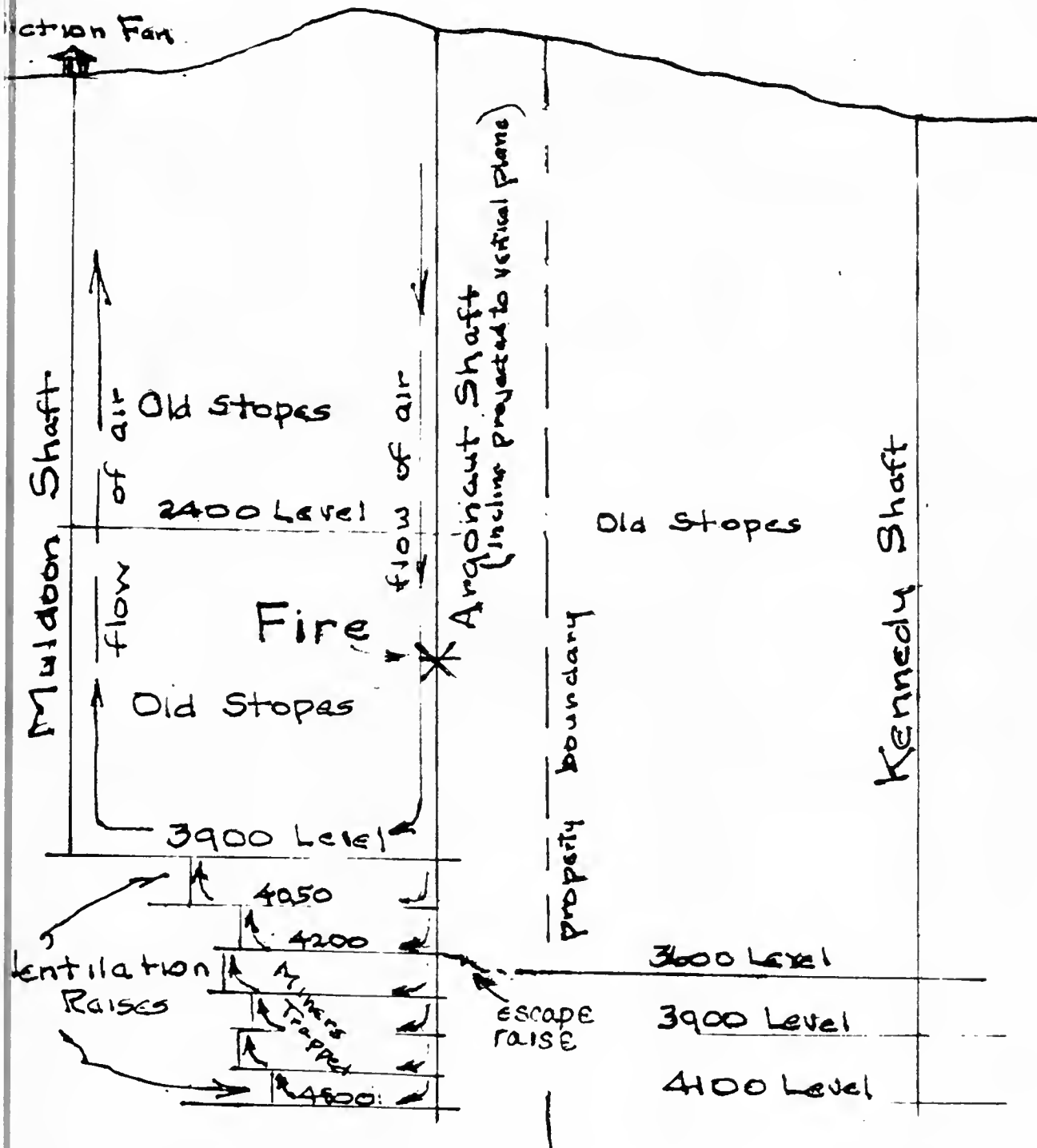
Swent: Those are memories you don't ever lose.

Perry: No. [pause]

Swent: What did you do at Carson Hill?

Section F
Muldoon Shaft
Flow of air
Ventilation
Rail

The Argonaut Disaster



Workings of Argonaut and Kennedy Mines
 Projected on a vertical plane
 (modified from sketch by T.A. Rickard - Eng & Min Journal - Press)
 September 30 1922

SEE EXTERA



Stockton



Record

8:00 PM

Vol. LV. Two Years Three Months

STOCKTON, SAN JOAQUIN COUNTY, CALIFORNIA—MONDAY, SEPTEMBER 18, 1922.

No. 137.

ARGONAUT MINERS DEAD FOUND ON 4350 FT. LEVEL

Bodies Are Found In 5 Feet of Seepage Water Behind Wall

able for the removal of dead bodies, and other equipment were immediately sent down into the mine.

Byron O. Pickard sent up word that he had established a fresh air base on the 4200 foot level of the Argonaut where the oxygen tanks of the apparatus men could be replenished without the necessity of coming the surface.

An earlier bulletin coming from the depths of the mine read:

'The rescue crew has gone down to the 4350 level and have signalled back to the men on the 4200 foot level that they are all right. They asked for a rescue crew to join them on the 4350 level. They have not found anything yet.'

The airtight bulkhead kept the seepage water from flowing all of the underground workings of both the Argonaut and the Kennedy mines, said tonight after examining a map showing where the bulkheads were found that evidently the mine had been flooded.

The airtight bulkhead kept the seepage water from flowing all of the underground workings of both the Argonaut and the Kennedy mines, said tonight after examining a map showing where the bulkheads were found that evidently the mine had been flooded.

Chronology of Argonaut Mine Disaster

August 27 (Sunday)—While ascending shaft after taking lunches to miners in lower levels of Argonaut mine shortly before midnight, Shift Boss Clarence Bradshaw and Skid Tenders Michael Jago and Steve Pasalich found shaft choked with smoke. As they neared 3600 foot level the skip was drawn upward through raging flames, much of the timbering having been burned away. Forty-seven miners, working on the 4300, 4600 and 4500 foot levels of the mine were cut off from escape and entombed in burning mine.

August 28—Many tons of water were poured down the Argonaut shaft, but after hard and desperate fighting it was found that the flames could not be extinguished in this manner and there was danger of flooding the lower levels with water and drowning the men entrapped below the fire zone. Officials of Kennedy mine, which adjoins the Argonaut, offered to cut through from their mine and attempt rescue.

[Kennedy and Argonaut mines formerly were connected in lower levels, but in 1919, when Argonaut mine caught fire, both mines were flooded in attempt to extinguish flames and were idle for two years thereafter. To prevent repetition of fire and flooding, openings connecting mines in lower levels were closed by bulkheading.]

August 29—U. S. bureau of mines rescue men, equipped with oxygen breathing helmets, descend Argonaut shaft with fire fighting equipment. Find flames raging on 2600 foot level. Fire evidently burning downward. Mine crews begin opening old drift leading from 3600 foot level of Kennedy toward 4200 foot level of Argonaut in attempt to reach imprisoned men.

August 30—Second drift being opened in Kennedy. Attempt will be made to reach imprisoned men from 3900-foot level as well as from the 3600-foot level. Argonaut shaft is sealed with bulkheads at the 2500-foot level for the purpose of smothering the flames while poisonous gases are drawn out through the Muldoon air shaft, which connects with the main shaft through levels above the fire zone. Pipe is inserted in bulkhead of main shaft and fresh air forced downward.

August 30—Mine owners hold conference with state and federal officials and appoint an executive committee of three consisting of V. S. Garbarini, superintendent of the Argonaut; E. C. Hutchinson, president of the Kennedy; and Fred L. Lowell of the state industrial accident commission to direct rescue operations. Two tunnels in Kennedy mine advance slowly toward Argonaut boundary.

September 1—Fire in Argonaut shaft believed practically out. From detour in the 3500-foot level of the Kennedy, it was decided to make use of open

crosscut, thus avoiding clearing 200 feet of muck.

September 2—Advances on 3600-foot level impeded by ore car squag imbedded in muck. Diamond drills arrive from Berkeley and if proper ground can be obtained will be used to bore large-diameter holes through to points where men are believed to be entombed. Proposed to send food, air and water through tubes to imprisoned men.

September 3—Miners engaged in rescue work in Kennedy report sounds of blasting, apparently coming from Argonaut. Believed entombed men are signalling to rescuers. Progress in drilling through green stone on 3600-foot level averages foot an hour.

September 4—Diamond drills cannot be used as yet because of formation of ground. Preparations under way for assisting men when rescuers break through.

September 5—Air found seeping through from Kennedy to Argonaut revives hope that men may be found alive. Green stone crosscut on 3600-foot level almost complete. Crew on the 3900-foot level have 200 feet yet to go.

September 6—Crew on 3600 foot level finished cutting through hard green stone crosscut into main drift and found it clogged with muck. Have 353 feet of clogged drift to clear before reaching face of seventeen foot raise into Argonaut. The 3900 foot level crew have 175 feet to go.

September 7—Dr. L. H. Duschak, consulting chemist, announces five thousand cubic feet intensely poisonous gas per minute pouring out of Muldoon air shaft from Argonaut mine. Man exposed to gas would probably become unconscious within a minute and die within a few minutes if not revived in fresh air at once. Faster progress is made on both levels of Kennedy.

September 8—Very discouraging progress made in both levels during past 24-hours. Both drifts badly clogged.

September 9—Dr. Duschak finds no evidence of putrefaction of dead bodies in tests of air coming from Argonaut mine. Executive committee says water suitable for drinking purposes can be had in mine's lower levels. Believe most robust men will survive. Argonaut mining company offers \$5000 reward to first crew to break through from Kennedy mine.

September 10—Rescue men on 3600 level encounter old stope which Superintendent Garbarini believes may be entered, avoiding necessity of clearing considerable length of tunnel. Will explore it tomorrow.

September 11—Use of stope found impossible. Garbarini finds gas pocket in stope and is slightly gassed while exploring it.

Governor Stephens sends Clarence E. Jarvis of state board of control to Jackson to represent him while rescue work progresses. Jarvis sits with execu-

Eds. note: Mr. Perry includes this "for what it is worth, with some reluctance because of its flamboyant, exaggerated character."

tive committee at all conferences.

September 12—Executive committee denies state troops are to be called to Jackson when hour of rescue comes.

September 13—Byron O. Pickard, district mining engineer of U. S. bureau of mines, arrives by airplane to take charge of rescue of entombed men. Prospects of entering mine by Friday morning shattered by old ore chute which brings down large quantity of muck to be cleared from 3600 foot level.

September 14—Crew on 3500 foot level now within forty-four feet of face of drift when seventy-seven foot raise will be started. Plans laid for removal of dead bodies in sealed canvas bags.

September 15—Attempt to reach face of 3600 foot drift abandoned and rescuers start raise up through roof to 4200 foot level of Argonaut. Believed cannot reach men before Monday.

September 16—Men working in 3600 foot level disregard all rules of safety. Firing three rounds of blasts every six hours and returning to face of raise immediately after firing without waiting for blast fumes to clear. Ben Fuller and Edward Murphy gassed by blast fumes and brought to surface to be revived by first aid.

September 17—This is the twenty-first day of the disaster. Rescuers on 3600 foot level fast nearing goal. Hope that they will reach through Argonaut boundary before midnight. Deputy sheriff prepares to hold funerals.

Perry: I was assistant engineer with the principal job of doing the surveying. My only real engineering achievement there was to survey and run a second exit raise and this happened immediately after the Argonaut incident. Probably our management was spurred to do this. We had an internal shaft from the 3000 level to the 4200 level. There was no second exit, so we started a 400-foot raise from somewhere between the 3000 and the 4000 to make a connection through to the 3000 level. It was an inclined raise and I had to make my survey down the main 60-degree incline operating winze. The management was so hard-pressed to get out the rock that the hoisting skips were kept going on a 3-shift basis while I had my transit in the manway trying to take sights down that shaft. I remember rocks, small pieces flying off the skips, as they whizzed past me, and I wondered whether I was going to save either my transit or my head. [laughter] We finally got the survey down to the point where the raise was designed to start and it was driven on lines checked every few rounds to keep the heading on course. I was very happy when the day came that we broke through and the connection was within a couple of inches of being on the mark.

Swent: Do you recall how much you were paid at Carson Hill?

Perry: I was paid \$150 a month. I thought that was pretty good pay in those days.

Graduate Study At Columbia University, 1923-1924

Swent: So then you left all that to go to Columbia?

Perry: Yes, and it was a five-day train ride in those days. I arrived at Grand Central Station in New York City, and as I exited from the station, there was a newsboy shouting, "Berkeley destroyed! Berkeley destroyed!" which was the first I heard of it. I had left California just before the disastrous fire of North Berkeley in September, 1923. Again, as in San Francisco, the homes of both my parents and my aunt and uncle were destroyed. That last event was too much for my mother; she was stricken with a heart attack and died within two months after the fire.

Swent: Where was your home in Berkeley?

Perry: North of the university campus on Virginia Street just below Euclid.

Swent: And that was the part that was destroyed. Oh, that's terrible. But you stayed on in New York; you didn't come back to California.

Perry: No, I stayed at Columbia until my mother's death, and then I came back, but just for a short trip and then went right on back and continued with my courses at Columbia.

One of the things that Professor Raymond had advised me was to continue my mining engineering work, and he suggested it would be of professional benefit to get an M.E. degree from Columbia, which was at that time a six-year course as opposed to the four-year course at the College of Mining in Berkeley. I was in favor of that, and submitted my California grades for review. Raymond arranged interviews with different faculty members. Peele was then one of the leading mining professors at Columbia and the author of the famous Mining Engineers' Handbook. Meeting with Peele he asked me, "What did you get in the course Strength of Materials at Berkeley?" I was proud to tell him that I had received an A, because that was one of the toughest courses that was given on the Berkeley campus. He said, "I think you'll have to repeat the course here. We can't accept the credential from the University of California."

I was so distraught at that; I felt it was a snobbish attitude he was taking. I knew that the Columbia course couldn't be tougher than the one at Berkeley. It so influenced my thinking, that I decided rather than going ahead with my plan to get a mining engineer's degree I would get a Master of Arts in geology at Columbia. I changed my whole curriculum, with emphasis on courses in geology. I took one course in mining under Raymond, and another course--I believe in mine accounting--that I found to be interesting. But most of my work at Columbia was directed towards geology.

I decided that the training and the education that I had received at Berkeley as a mining engineer, was as good as I could get anywhere, and that there was little use of trying to "gild the lily" by getting a mining engineering degree from Columbia. I was better off specializing in some subject, and I was interested in geology. Increasingly I thought that maybe I would go into the oil business, because that looked so attractive from a monetary standpoint at that particular time in the early twenties, with all the important discoveries being made in the Southwest and in Southern California.

I had that pretty much in mind when I agreed verbally to accept a job with the International Petroleum Company in Mexico. It just happened that Reno Sales, chief geologist of Anaconda, was visiting the Columbia campus and had given a talk to a little club we had there called the Journal Club in which he told us about the work that was going on in Butte, Montana. I was impressed with his talk and with the man personally, and introduced myself after the program. He asked me what I was planning to do upon graduation,

and I told him I was planning to go with an oil company. He looked at me rather disdainfully and said, "The trouble with you is, you want to get rich quick."

Sales's point that money wasn't everything sunk in, so much so that the next morning I looked him up at his hotel in downtown New York and asked him, "What about a job in Butte, Montana?" [laughs] He accepted me and said that there'd be a place for me as soon as I finished my work at Columbia. So I arrived in Butte in June, 1924, and started work with the Anaconda Company, and my whole professional life has been with that company.

Swent: How much was your starting pay there?

Perry: A hundred and thirty-five dollars a month.

Swent: Before we go into the Butte experience, I did want to question you a little bit more about your feelings about the difference between Columbia and Cal.

Perry: I found that Professor Raymond was a very helpful, friendly individual. I was impressed with him when I had that short visit with him at Carson Hill when he was making the examination and I was his helper. I found that when I arrived in New York, he was very generous and helpful to me. I, of course, was shocked by the news that our home had been destroyed in the Berkeley fire and about my mother's illness and he immediately pulled all the strings he could and established communications with Berkeley, contacting my family. I found the man was an extremely decent and kind individual.

I also found that generally at Columbia, this was the nature of many of the faculty, despite the brush-off I had received from Peele. There was actually at Columbia, I thought, a more intimate and personal relationship between students and faculty members than I had found at Berkeley. This may be a distorted viewpoint, because after all, I was a graduate student at Columbia, and maybe graduate students did receive more attention and more notice from the faculty than they would have received as undergraduates. But it was my experience that Columbia gave a great deal to its graduate students. I have a feeling of deep appreciation for what Columbia did for me. It is a second alma mater, and it in no way detracted from the fact that my first loyalty was to Berkeley.

Swent: Did they give you help in getting a job, then, also?

Perry: They were helpful, yes, in the sense that they had lined me up with the job with an oil company, and when I didn't accept that, it was through a meeting with Sales who was speaking under the auspices of

Columbia University when he gave the talk that impressed me so much and made me want to _ in his department as a geologist.

Swent: And he was from Columbia?

Perry: He was a Columbia graduate, although he had done his undergraduate work at Montana State. He went to Columbia and took two additional years and received his mining engineering degree from Columbia.

Swent: Is there anything else you wanted to say about the Columbia experience? Did the fact that you were in New York City enter into your education?

Perry: Well, of course it did! New York was a great place for a young man to visit at that period, and I made some good friends. I enjoyed the life in New York City. It was a lot of fun, and of course, as fortune would have it, when I finally established my home in the New York area thirty-three years later, I felt that I knew the place, because I'd been there as a student in years gone by.

Swent: And of course, at that time, most of the big companies had their head offices in New York, didn't they?

Perry: That's true. The AIME [American Institute of Mining and Metallurgical Engineers] had its headquarters there. It was a very active organization.

Swent: And the Mining Club was there?

Perry: Yes, the Mining Club was there. There were a lot of advantages to being in New York. I had joined the AIME when I was a student at Columbia. They were very active on the Columbia campus. We had a student group and I attended all of the technical sessions and the social gatherings which gave me an opportunity to broaden my contacts with the mining fraternity.

Swent: What was going on in the geology world at that time? When did the Wegener theory come in? Was it about that time?

Perry: Well, the Wegener theory had been proposed before that, I believe about 1912. The idea of continental drift was a controversial subject, and I was impressed with it simply because of the beautiful physical fit between the east shoreline of South America and the west shoreline of Africa. It struck me as though it made a good deal of sense, but it was not accepted generally by the geological profession until much later, and the general ideas of plate tectonics took over and then it began to make more sense. But I think Wegener was really the father of plate tectonics.

Swent: And this was coming in when you were in school?

Perry: As I recall, it was something that was discussed as a very far-out, hypothetical, questionable sort of geological idea. The main discussions about the geology of ore deposits at the period were between the school that had been generally led by Josiah Spurr of United States Geological Survey, and a group including Allen Batemen, Waldemar Lindgren, and others who thought that Spurr and his ideas about the relationship between ore deposits and pegmatites was a far-fetched and erroneous sort of an approach to the nature of ore genesis. Their ideas, largely led by Lindgren, favored the theory of replacement over long, protracted time intervals, which ideas could be more readily corroborated by microscopic study of the ore minerals.

Generally, I think that their ideas were correct, although I think that Spurr, like many extremists, had simply gone too far. I think that his ideas about pegmatites, if treated with some degree of moderation, do fit into the overall picture of ore genesis. That thought was substantiated when I began my work at Cananea in the study of the great La Colorada ore body, which was at that time one of the greatest high-grade concentrations of copper in the world. I felt that there were very intimate relations between the magma and mineralization, and that those relations could be demonstrated and could be used in exploration work. So that Spurr's thoughts, while they were discounted and ignored by the profession generally, I think did have some substance. It was interesting that this sort of thing was going on while I was taking my graduate studies at Columbia.

Swent: And you were made aware of it.

Perry: And I was made aware of it, so I knew a little bit about the pros and cons of the argument when I began my own field work and decided that maybe Spurr wasn't 100 percent wrong after all. I think there are many things like that in a science like geology, which is not an exact science--it's more of an art, in many ways--and requires a good deal of balanced judgment as to what you want to accept and what you want to treat with a good deal of suspicion, or at least caution. [laughs]



Reno Sales (left) presenting Vincent Perry with the Jackling Award of AIME, St. Louis, Missouri. March 1, 1961.

II MINE GEOLOGIST FOR ANACONDA IN BUTTE, MONTANA, 1924-1928

Swent: Are we ready to move on to Butte?

Perry: Sure. One of the advantages of working as a Butte geologist was the opportunity it offered to learn the fundamentals of applied mine geology. Butte practiced a special style of mapping and using geology in mine operations. The system had been developed by Reno Sales and probably to some extent by his predecessor, Horace Winchell. Sales's contribution earned him the title "Father of Mining Geology" by the mining profession. The Butte Geological Department was considered an excellent postgraduate school in mining geology.

The field mapping system was simple and practical. Red lines for mineralization and blue lines for faulting were carefully and skillfully weighted using sharp pencils to emphasize proportionate widths and strength of mineralization and faulting. Disseminated mineralization was shown by red dots, and brecciation by blue stippling. Rock formations were represented by appropriate symbols. The resulting portrayal had both qualities of engineering accuracy and artistic expression.

A simple innovation was to get away from the use of bound notebooks, which engineers and geologists had used almost exclusively in the past, and go to a flexible looseleaf system in which each sheet upon which geological notes had been recorded could be filed properly, indexed and thus made available for use by the geologist who had originated the sheet, as well as by successors who followed and continued mapping the same area.

Underground mapping was done during the early part of the day and office work in the afternoon. Notes were transcribed and plotted by hand on plan maps and sections, thus creating the basic geologic record. The system included copying of additional maps for the mine superintendent's and foreman's offices. That way, the information gained from the geologists' observations could be graphically displayed so mine operators could use it. It was an effective way to coordinate geological and mining activity.

In addition, there was an excellent system of written recommendations. Driving of each development heading was based upon the recommendation of the mine geologist which then required the approval of the mine superintendent. Starting and stopping of each exploration and development heading was the responsibility of the geologist.

So it was a system based not on any high technology, but rather on good, hard-headed common sense and the development of a team approach so that mine geologists and operators worked together. That doesn't mean that they were always in harmony; there were disputes, but there was also an opportunity to take those disputes to a higher authority. It was a system that required hard work but had few flaws and it operated effectively.

Generally there was close rapport not only with the bosses but with the miners. In my opinion it was typified in the by-word between miner and geologist passing in a crosscut or drift: "How's she going? Did you find any ore today?" [laughter]

I think it would be interesting to start with a few of my first underground experiences. One of the first--and it was a very fortunate one--was to map a newly discovered ore body on the 500 level of the Diamond Mine. Upon my arrival in Butte I was assigned to be geologist for the Diamond Mine. My first day underground, I had the opportunity to see this beautiful face of high-grade chalcocite mineralization averaging between 30 and 40 percent copper across a width of about ten feet. It's hard to believe that anything like that existed. Yet in perspective, this was the type of ore that was found by the early-day prospectors when they had mined out the first silver showings and had gone down into the copper zone, finding abundant secondarily enriched chalcocite along the Anaconda lode. Those ore bodies were restricted in vertical range and occurred in a zone of strong enrichment usually several hundred feet in vertical extent. Below the chalcocite enrichment there was primary ore which generally averaged in the order of 4 up to 10 percent copper. But in mapping that high-grade chalcocite ore body on the Diamond 500 level, I was lucky enough to observe the last of the secondarily enriched high-grade ore bodies found in the Butte district.

The Lawsuit with Senator Clark

Perry: Shortly after that, I had an opportunity to participate in the last of the great litigations that characterized Butte's history. The

War of the Copper Kings is a well known event, and its glamorous phases and all of the things that went on during those clashes between the titans of the industry that met in Butte in the early days, were pretty much a thing of the past when I arrived in Butte, but there was one fight remaining. That was the argument between the Anaconda Company and Senator W. A. Clark over ore bodies in the Elm Orlu and Badger mines. The Badger was owned by Anaconda; the Elm Orlu was owned by Clark. Clark contended that because of the extralateral rights prescribed by the Mining Law of 1872, he could follow a vein from the Elm Orlu outcrops down into the Badger, and that since the Elm Orlu was the older claim, he had rights to all the rich ore Anaconda had mined out of the Badger and to its unmined deep reserves.

Sales, defending Anaconda, had taken the opposite viewpoint, and by beautiful mapping and very careful attention to detail, effectively demonstrated that what Clark was claiming as a lode was in fact a post-mineral fault, and that there was no extralateral right involved in this fault zone. I had an opportunity to go underground as an assistant to Sales and with some of the other geologists, particularly Chester Steele, who was the Badger mine geologist and had acquired a very intimate knowledge of the geology of that whole area. I was impressed with the excellent mapping done in support of the Anaconda case.

About that time, Clark produced some of his experts, and one of his professional men was William Colby, from Berkeley, from whom I had taken my course in mining law. It was quite a shock to me to be on the opposite side of a man I had respected as a professor of law. But later, as I had more and more contact with lawyers, I understood their professional attitudes; they can get themselves involved in situations on opposite sides that laymen have a hard time understanding or justifying.

But at any rate, that was a fine experience for me; I learned a lot about the importance of applying geology to the difficult legal situations involved in the interpretation of the 1872 Mining Code. During the actual court trial, I had the good fortune to be selected to handle the maps, so that I put the exhibits up on posters and charts before the judge, and in that way I saw firsthand how a court proceeding is carried on in a matter involving damages running into many millions of dollars. The case was decided in Federal Court by Judge Bourquin, and I found him an extremely interesting character. Sitting on the bench, he asked intelligent questions, and when his questioning was completed, he said, "Now, gentlemen, I'm going to go underground with you people, and we're going to go up in those raises and we're going to see these various points in which you are in disagreement." He said, "I'm going to decide for myself, although I'm not a geologist."

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Swent: And did he go down?

Perry: He did go underground, and he corroborated Sales's geology and gave his decision in favor of the Anaconda Company. The case was appealed in San Francisco Appellate Court, and ruled in favor of Anaconda, and the Clark properties were eventually purchased by Anaconda. So that was a fine early experience in my career of how you use geology in connection with the law, and the use of good, factual information in proving your point.

The Mining Law of 1872

Swent: Did you appear later in cases as well?

Perry: No, that was my only experience, and, as a matter of fact, the Clark-Anaconda case was the last of the law suits in the Butte district. Sales has written a complete case history of all of those litigations in Butte. It's worthwhile to review critical points that are involved in the law of the apex. The concept of the code had its start in the early days of California mining where the miners were working on the Mother Lode and the geology was relatively simple. There was a quartz vein that carried the gold and that had an inclination or dip to it, and as it dipped away from the outcrop, it would in some cases dip outward under a claim that was owned by someone else. The miners in their local councils decided that the owner of the outcrop was entitled to the vein and that it could be followed downward even to the "center of the earth". It became a practice among the miners in California to adjudicate their problems on the basis of this simple law of following the vein downward even if it extended under a neighboring property owned by someone else.

In 1872, the law was codified by Congress formalizing the traditions and the customs of early-day mining in California because that was the best precedent they had. So Congress wrote into the law the right to follow a vein downward regardless of the ownership above the downward projection of the vein. Well, when you applied that to Butte, where Butte has such complex structural geology, where the veins are not simple, through-going features but often zones of branching, crossing, connecting, diverging fractures filled with copper ore and often faulted in various directions--up, down, and laterally--the complexity presented by that sort of

situation made this law a very difficult thing to apply. It was little wonder there were disputes in Butte and unscrupulous operators could make illegitimate claims on ore that didn't belong to them. That's why there was so much divergence of opinion between highly qualified men. Not because they were essentially dishonest, but because in their own way they felt that they did have a position and that they could uphold it. So that you found experts, highly qualified geologists, on both sides, arguing vehemently against each other. And with some justification.

The situation exists to this day and I don't think there's any way to correct it. The law has been in practice for so long; the extralateral right is part of it, and the only way to operate with it is to follow the example of Anaconda--it finally consolidated practically all the adverse ownership in Butte by purchase, settlement out of court, and actual court decisions. It worked to the advantage of Butte because it gave an opportunity to consolidate from an operating standpoint. Ventilation could be centralized; drainage and pumping could be localized in ways that produced the most efficient overall operation. I think it did a lot for the Butte district in that sense, but in the meantime, it's easy to understand why there would be some disgruntled claim owners who felt that they had been unjustly treated because of the leverage of the big corporation. In fact, the consolidation of properties enhanced the value of individual lode claims and many were sold at premium prices. The Mining Law of 1872 has been equally good for both the small miners and the big company because each, within its own limitations, has the right to locate a lode claim with inherent property rights on government land. It was a great experience for me to see all this and to participate in it at that early time in my career.

Romance and Marriage

Swent: You might tell a little bit about your living situation there.

Perry: I came there as a bachelor and I had a room at a little hotel on Park Street. I ate at Fleming's boarding house, where several other young engineers took their meals. At the table there was a very lovely young lady who I found out worked at Hennessy's department store, was their leading model and ran the glove department for the store. I was so impressed with her, not only with her charm and beauty but also her very quick wit. Most of the boarders were men, and with her neat turns of speech she could handle all of them with one hand tied behind her back. I marvelled

at her humor, her intelligence, and at how well-informed she was. She came from a broken family; her father had moved to Canada and had taken her with him, and had put her in the convent in Calgary. The nuns had raised her as a little girl and she had been educated and trained by them. She came back to Butte and lived initially with an aunt and got a job at the Hennessy department store, which was considered one of the first-class department stores of the region.

Swent: What was her name?

Perry: Her name was Margaret Moore. Her father had come from Ontario, Canada, had mined in Butte, then gone up to Canada, had a ranch in Alberta, and had been successful in raising wheat there. He'd kept his one and only daughter in school at Calgary.

So within a year and a half, we were engaged and ready to be married. We were married November 16, 1926. It snowed about eighteen inches that morning and we had tickets on the North Coast Limited to go on our honeymoon to California. After the marriage ceremony at St. Patrick's Cathedral and the wedding breakfast at the Finlen Hotel, we were driven to the depot by one of my geological pals, but we couldn't get up to the Northern Pacific station platform because of the snow. This was my first experience carrying my bride. I had eighteen inches of snow to carry her through, from the freight depot a hundred yards or so to where the North Coast Limited was waiting. And I was thankful that I didn't drop her. [laughter]

Swent: Who were some of your other pals at that time?

Perry: I think one of my best friends was Alex McDonald. Alex was a member of the Geological Department and a Butte man, and a graduate of the Montana School of Mines. He was best man at the wedding, and afterwards, when I left Butte, he and his bride, Florence, bought all our furniture and our belongings that we weren't able to take into Mexico.

The Anaconda Company's Depression Relief Efforts

Perry: Shortly afterwards, the great Depression started, and Alex was appointed to direct the Depression efforts of the Anaconda Company to take care of a lot of people in Butte, Montana. Despite the fact that corporations sometimes get the reputation for being heartless, I know for a fact that Anaconda through Alex took care

of a lot of homeless, jobless people, feeding and sheltering them during those early days of the thirties and the company footed the bill for everything. Alex has told me many stories about the fine things that were done by the Anaconda Company during that period. Alex was the fellow that carried out the work; he ran the whole show; he had an organization under him and took care of a lot of people. Those were, of course, the days before there was any government help. In Butte, the Anaconda Company was the only organization that had the money and wherewithal to do a thing of that type.

Alex later became my assistant in Salt Lake City, and he did a great job in the developments that I'm sure we'll be discussing later on.

The Labor Situation in Butte

Swent: What about the labor situation in Butte at that time? In the early thirties?

Perry: We left Butte for Cananea in 1927 and the labor situation was fairly good at that time. In the early thirties there was a change. Wages were tied to the price of copper, and, of course, when the price of copper slumped to practically nothing, the miners took a terrible beating. There were layoffs and a lot of dissatisfaction and unhappiness, but there was nothing like the much more difficult situations that developed years and years later. At that time, I thought the miners generally, and the management pulled together pretty well.

I knew many of the miners, and we were friends and chatted together. As a matter of fact, I often wondered whether some of them were distant relatives of mine. That goes back to the start of our family in California, when, on my mother's side, her father and mother arrived here right after the admission of California to the Union. My grandmother was from County Galway, Ireland.

Swent: What was your mother's name?

Perry: My mother's name was Sarah Denis and her mother's name was Ann Mulhare. And she had cousins who, after the gold mines generally played out along the Mother Lode and things opened up in Butte, migrated there. But I hadn't kept track of distant cousins and didn't know whether I was related to any of the fine people I met

in Butte. It was predominantly an Irish community, although there were also a lot of "Cousin Jacks" from Cornwall, Italians, Finns and other ethnic groups. But generally it was an Irish labor force.

Swent: Kelley was one of the founders.

Perry: Yes, Kelley's family were early day miners in California who moved to Butte. He studied law--I'm not sure, I think it was at Michigan--entered the legal department of Anaconda and moved up through the executive ranks until he was chairman of the board of the company. He was an able man and a kindly, fine person. I was a great admirer of Mr. Kelley. I always thought he'd have made an excellent statesman if he'd moved to Washington, D. C. He had eloquence, ability, a keen mind, and high integrity--qualities we like to associate with political office.

In fact, men of such character were typical of Anaconda leaders of that period. John D. Ryan was the same type man. He was from Michigan, and he was chairman of the board before Kelley. James Hobbins was another man of the same caliber. It was a source of pride to have that kind of men heading the company.

Swent: I have here some names: Al Taylor, George Heikes, and Justin Gowan. Do you want to mention them?

Perry: Yes. Those were all young members of the geological department who made rapid progress with the company. The background of all this related to the expansion of Anaconda's mining activities abroad. One of the big moves that Anaconda made was the acquisition with W. A. Harriman of the very rich zinc and coal mines of Poland. Sales decided that a geological department was needed there, not only in connection with the execution of operating work, but also the probability of expanding ore reserves in that part of Silesia. So he selected Justin B. Gowan and George Heikes, young Butte geologists, and sent them over to organize a geological department in Poland modeled after the Butte department.

At Chuquicamata in Chile, Sales organized a department, first with Walter March and then with Al Taylor, both Butte geologists, in charge. At Potrerillos, Chile, the organization was similar planned and Walter March was eventually moved to that office.

At about the same time, there were important discoveries being made at Cananea in Mexico, and Anaconda had a minority interest in the Cananea district. So Sales moved me to Cananea to establish a geological department there, modeled after Butte. Slightly later, Roland B. Mulchay, another young Butte geologist, was assigned to the geological department at Cananea.

This represented a major expansion of geological activity and of course the exploration work was carried out from those various centers rather than from Butte, along with the application of geology on a day-to-day basis in relation to the operations. So it was a very important move that enhanced the use of geology in mining operations.

Swent: Sales kept his center in Butte?

Perry: Sales kept his headquarters in Butte. Yes.

Swent: And as a young geologist came in, he would be trained there first?

Perry: He'd be trained there. All of them would be trained in Butte because having Butte experience in sampling, engineering and geology was considered most helpful and desirable. And, of course, there was an important department maintained in Salt Lake City. Paul Billingsley was originally in charge there and had a staff of men that covered the Park City, Tintic, and the Bingham Districts.

One of my first experiences, another thing that Sales gave me an opportunity to do after my first year in Butte, was to serve temporarily as an assistant to Tom Lyon, who was making a visit to many of the mining districts of Colorado for the purpose of stimulating the flow of zinc-lead concentrates to the International Smelter, a subsidiary of Anaconda at Tooele, Utah. We spent a month visiting most of the mining districts of Colorado, which was a liberal education for me.

Swent: What about Dave Sharpstone?

Perry: Dave was a Cal graduate who worked as a Butte geologist. Later he served as geologist at the Roan Antelope Mine in Northern Rhodesia.

Swent: Were you at Mountain Con[solidated] and Mountain View?

Perry: Yes, after the Diamond Mine, I was assigned to the Mountain View and Mountain Con mines as mine geologist. Again, it was a very fortunate assignment because the geological department had designed an exploration crosscut from the Diamond Mine to cut the extension of the State vein, which was one of the principal sources of production at the Badger Mine. It was based upon the theory of a zonal arrangement of the minerals in Butte, where the central core of the district is generally richly mineralized with copper sulfides. Around it there is a halo of zinc and subordinate lead; beyond that, silver and manganese. A crosscut was planned to reach out from the Diamond and cut the State vein in the copper zone.

The crosscut had been carefully laid out before I arrived in Butte, and my job was simply to keep track of it.

I remember going into the crosscut late one afternoon just before the miners were ready to blast, and seeing a face of the hardest, freshest, toughest "tombstone" granite you ever saw in your life, and deciding that somebody had made a terrible mistake, that there couldn't be ore in close proximity to granite as forbidding as that. The next morning, Eddie Kane, the mine foreman, called me up and said, "Vin, get up here and see what we have!" I went up to the Diamond and into that crosscut and immediately ahead of the very tough-looking, uninviting rock I had observed the previous day, the miners had blasted into a beautiful vein of high-grade bornite and chalcopyrite.

I learned right there that rich ore can occur without any significant alteration of the adjacent wall rock. That development was extremely important because its discovery on the 2600 level of the Diamond Mine--while it didn't have any great length on that particular level--represented the top of an important series of big copper ore bodies. By exploring on deeper levels in the adjoining Mountain Con Mine, the trend of those rich copper ore bodies was picked up. I was assigned the job of geologist in the Mountain Con so had an opportunity to follow this discovery right on down into some of the most spectacular high-grade ore that was ever developed anywhere. The ore shoots were in total over five thousand feet long and varied from ten to up to thirty feet wide. Grades sometimes went up to 6, 7, or 8 percent copper with average grade of about 4.5 percent copper. Later developments on the nearby Syndicate and High Ore Veins exposed similar spectacular copper ore bodies.

So it was another great experience. I wasn't in Butte long enough to see much of that development but at least I was there at the beginning. I left shortly after the Diamond Mine discovery to start work at Cananea, Mexico. But I heard from time to time about the development going on in Butte, and it was exciting.

The Importance of Underground Mining Skills

[Interview 2: March 8, 1990]##

Swent: We were just talking about the fact that the mining community is such a small one and people who came from Michigan--the "Cousin

Jacks" from Michigan--went all over the country. You were starting to say something about going up to Butte.

Perry: Many of the Butte miners came from Michigan, and the ideas that they brought with them, the skills and the ability to handle very difficult day-to-day underground mining problems, contributed a lot to the success that was achieved by mining companies in extracting ores under difficult operating conditions.

These impromptu remarks are simply, in a way, motivated by the fact that I had read Jim Boyd's interesting story* about his activities in Michigan and the problems he faced when he took over, first of all, as a government representative, the efforts that were being made to help a subeconomic mining situation that existed at the White Pine Mine and make it a source for copper needed for our impending entrance into the Korean conflict. Later, Jim inherited all of this in a private capacity when he was asked to assume the role of president, and I believe chief executive officer of the White Pine Mine. He faced these things with a good deal of courage, skill, initiative and ability. The fact that under his direction the White Pine Mine didn't turn out to be a highly profitable operation was certainly no fault of his. Again, it reflected the difficult problem that the mining industry faces in undertaking jobs that require underground engineering skills, not only on the part of management but on the part of the individual miner, too.

That's one reason, I suppose, the mining industry has gravitated in recent years to large open-pit mining, because it's so much simpler and so much easier to do. While there are ore reserves close to the surface that can be tackled by these methods, that's going to be the trend for the immediate future. However, for the long-term pull, we must remember it is problems such as Jim Boyd faced at White Pine which will have to be solved in the coming centuries, if we are going to maintain a production of essential metals like copper.

Swent: We had stopped yesterday just about the point where you were leaving Butte. I wondered whether there was any more that you wanted to say about Waldemar Lindgren. Was he a significant person in your life? Did you have firsthand experience with him?

Perry: Only briefly in connection with the W. A. Clark-Anaconda litigation. He was one of the experts retained by Anaconda to

*James Boyd, Minerals and Critical Materials Management: Military and Government Administrator and Mining Executive, 1941-1987, Regional Oral History Office, University of California, Berkeley, 1988.

testify during the court proceedings. We had a few contacts with him in a very informal, off-the-record way.

One of the most humorous ones, I thought, was the meeting early in the morning before the start of the trial. I, with several other Butte geologists, had worked most of the night on a model that showed the three-dimensional relationships between the Elm Orlu Mine and the Badger Mine, which were the bones of contention in the litigation. Lindgren appeared right after breakfast and carefully inspected the model, perhaps for fifteen or twenty minutes. The young geologists all stood around, somewhat in awe of Lindgren's great reputation and the fact that all of us geologists had studied Lindgren's writings and his well-known textbook on geology. So we expected some profound statement from him about the geological relations exhibited by the model. Finally he stood back and said in his broad Swedish accent, "Vell, boys, dat's quite a muddle." [laughter]

That really was about my only contact with Lindgren. He did make one remark at that time about Anaconda geologists. He was reported to have said that Anaconda was making a great contribution through its young geological staff in the ability to locate the position of veins and the faulted segments of those veins. But he said he wished that those young geologists would devote more time to the problem of what the veins contained and how they were mineralized.

Making Mine Models

Swent: How did you make a model in those days? What were the materials used for a model?

Perry: They were made of soft metals such as lead that could be readily molded. These forms were then affixed to a rigid frame and suspended in such a way that you could look through the maze of workings and see their three-dimensional aspects. Then the geology of each working was carefully inked in with pen and brush. Thus, the structure of the veins and the position of the faults were shown graphically so that the geometry was much more readily appreciated by the layman and, particularly, by the lawyers of the court and, of course, the judge sitting on the case. It made an effective presentation, and the Anaconda model, I thought, was much more effective than the model presented by the Clark interests, simply because the Anaconda model had all of the detailed geology that had been mapped with great precision using standard Butte

methods, and thus provided an excellent three-dimensional presentation of the geological structure.

Swent: Was this a standard thing to do at that time?

Perry: Yes, it was, in connection with litigation work. Models were also used to some extent in presenting complex problems for geological study, but generally that wasn't the case. When you were presenting details of a structural relationship, you were talking to men that were well versed as mining engineers in the use of maps and sections. It wasn't necessary to make a three-dimensional picture for them. If, on the other hand, you had to make a presentation to a banker or a lawyer, models were of some real use. The use of the model in court and litigation activities was pretty much determined by the fact that you had to make your story clear and presentable to people that were not versed in the intricacies of engineering and geology.

Swent: It seems to me that this is an entirely different skill; making a model would call on different talents.

Perry: No, it really didn't. I think it was more a matter of ability to have good craftsmen. Actually, Anaconda maintained, during a large part of the litigation period, a model shop. One or two men were assigned to just that work and became extremely skillful in building these models. Some of the models have been preserved and given to universities. I believe there's at least one model, and perhaps more, at the Montana School of Mines, or Montana Tech.

Swent: So these weren't built by the geologists themselves?

Perry: Well, the men that worked in the model shop usually were geologists, because it was found useful to have men that understood the purpose and application of the model procedure and at the same time had the manual skills required to build the model itself.

Swent: Is this still done in about the same way now?

Perry: There's none of that being done now. In fact, the model shop in Butte was closed years ago, because the company had little use for models after the consolidation of properties following the litigation that ended with the 1926 Clark case.



La Colorada open pit, Cananea, Sonora, Mexico. Looking easterly, the Ajo Mountains in the background. March 1973. The picture illustrates the steep mining slopes maintained in the open pit because of the unusual hardness of the rock.

III CHIEF GEOLOGIST, CANANEA, MEXICO, 1928-1937

La Colorada Mine

Perry: Well, should we start with the change from the cold wintry atmosphere of Butte to the beautiful sunshine of good old Mexico?
[laughs]

Swent: Yes, we should. How were you told to go to Cananea?

Perry: Very casually. One day as I was bending over my drawing board working on a map, a shadow appeared behind me. I looked up and found the boss, Reno Sales, looking over my shoulder and handing me a little sketch that showed some heavy red lines beautifully drawn on a typical notesheet. On the note sheet there were a series of very high copper assays. He said, "Vin, would you mind just averaging the assays on this map and bring them in to me when you're finished?" I averaged the assays which, as I recall, showed somewhere between 15 and 20 percent copper with added molybdenum and gold values. I brought them in to Sales, and he studied them briefly, then looked up at me and said, "Would you like to see this kind of an ore body?" With an enthusiasm I had a hard time suppressing, I said I would be delighted. He said, "All right. Get your things organized, and you and I will start down to Mexico the day after tomorrow."

I went out that afternoon and visited the change rooms at the Mountain View and the Mountain Con Mines where I had been working, and gathered together my "digging" clothes. There was an early winter blizzard blowing across Butte Hill, and I remember the still-damp clothes began to freeze as I lugged them towards my home. I thought this was a real lucky break that I was leaving Butte at the start of the winter.

When I arrived in Cananea a couple of days later and started my work there, mapping not only underground but also doing a lot of surface geology, for the next thirty days there was nothing but beautiful blue sky and warm air, and I thought Mexico was one of

the most delightful spots I had ever seen. It had a climate that not only equalled but, because of the altitude and dry air, was much more invigorating than the lovely California sunshine that I had been used to in my childhood days. [laughs]

Swent: When was this?

Perry: This was in October 1927.

Swent: Were you already married?

Perry: Yes, I was married and I took my wife en route to Mexico to Berkeley, to stay with my sisters and father who were living there at the family home on Le Conte Avenue where they had moved after the Berkeley fire.

Swent: I see. She didn't go with you immediately.

Perry: No, she didn't go immediately because I had no assurance that this was going to be a permanent job. We decided that because she was pregnant and expecting the baby within a few months, it would be better for her to stay under the loving care and attention of my two sisters.

Swent: So that was an exciting time.

Perry: It was a very exciting time, and it introduced me to a whole new geological world. In the first place, Cananea was an independent company, although Anaconda had a large stock interest in it. But the discovery of this very high-grade ore body had promoted a lot of competitive interest, and I suppose one of the important reasons for my being there was as an Anaconda representative, to determine just how important, economically, this new discovery would prove to be.

This was La Colorada Mine. The story, briefly, of its discovery is an interesting one. Again, one very important character in the development was the well-known and respected engineer, Louis D. Ricketts. Dr. Ricketts had graduated from Princeton, I believe, in chemistry. His first job was as a geologist for the State of Wyoming. That is how he happened to land in the West. He was an exceptionally able man, and it illustrates how a man with an engineering and scientific background can adjust and move into specific situations that require special knowledge and the application of that knowledge to the problems they present. Dr. Ricketts was active, after his Wyoming work, in Arizona. He became associated with Phelps Dodge in Arizona and was instrumental in the development of the Nacozari operation of Phelps Dodge, where he served briefly as mine manager. Then he moved on

to other important professional work. I believe Dr. Ricketts' story is well told in some of the publications of that era, and just recently, I know, he was inducted into the so-called "Hall of Fame" in Arizona. A publication related to that event describes his many achievements.

Swent: Did you ever meet him in person?

Perry: Yes, I knew him well, and this goes back to the fact that I was able to impress him with the need for the kind of detailed geological work that I had learned to do in Butte under Sales's direction and how that could be applied to an entirely different situation in the Cananea district. At the time, Cananea had its own geological approach, which I thought was of very restricted character.

Swent: In what way?

Perry: In the fact that it was more of a theoretical geological approach--that is, the man doing it had a doctor's degree in geology, but he had no background at all in engineering, had no sense of the way geology should be applied in a mining operation.

I think Dr. Ricketts realized that, and had talked it over with Sales, because after I had been in Cananea several months, he visited the camp and had a meeting with the manager. He called me in to give my version of what was represented in the Colorado discovery and the promise it offered for further exploration of the Cananea District. After the meeting the manager, Mr. Evans, called me and said, "Dr. Ricketts, you know, is our principal consultant on mining operations, and he has asked me to offer you a job as chief geologist of Cananea to organize a geological department using Butte methods." So, in that way, I was severed from my Butte activities and became a permanent part of the Cananea operation. Eventually, I brought Roland Mulchay, a good friend of mine and a fellow geologist from Butte, to be my assistant, and we built up a geological staff there pretty much modeled on the Butte organization.

Applying Geological Knowledge to Mining Operations

Swent: Were you still employed by Anaconda?

Perry: No, I was employed by the Cananea Company, which had become a wholly-owned subsidiary of Anaconda. Anaconda had moved to acquire not only full control but 100 percent ownership of Cananea through

exchange of stock, so that I was working for a subsidiary of Anaconda, and in that sense I was under the general direction of Reno Sales. This was another thing that I feel is important in the application of geology to mining operations. There was always a very fine relationship between management at the local properties and the overall services of the geological department that were under the direction of Sales from Anaconda headquarters.

Swent: So you could call on them?

Perry: We could call on them for geological support, assistance, consultation, and at the same time the local management, which was certainly a well-equipped group from the viewpoint of mining talent and engineering talent --they would listen, and there was usually very little conflict between geology and management.

Swent: What were the opportunities for disagreement? Would it simply be that you would tell them that they should mine one place and they wanted to mine another?

Perry: Well, there would be disagreements. There always are among people with strong viewpoints.

Swent: I'm trying to think what these disagreements were specifically. Can you give an example?

Perry: Well, specifically, they would involve whether a crosscut should be stopped or whether it should be continued towards a certain target. One of the things we started at Cananea was the same type of thing that had been done for years in Butte. Before any development work was done, it had to be supported by a geological recommendation. The geologist made the study, wrote the recommendation; before it could be executed, it was reviewed by the mine superintendent, and went to the office of the general manager. The general manager then finally approved the recommendation or disapproved it. If he approved it, it was put into effect immediately. The question whether there should be some modification of the work--that is, whether the crosscut should be changed in some way or whether the work should be stopped after finding some unforeseen geological feature that had changed the concept of the original job--the geologist had the authority to say that this work should be suspended. If it was to be overridden, it was up to the manager to make that decision.

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Swent: Were there ever any cases where your recommendation was overridden, and you were upset about it?

Perry: No, I can't recall any situation involving serious conflict.

There were cases where we did a little arguing, but usually the people involved could be convinced. I suppose I was fortunate in the fact that Anaconda had a strong operating organization. It was staffed by men who had had engineering backgrounds and could appreciate the value of a well-thought-out geological approach and were willing to accept it. It was almost as though the geologist was treated as the doctor on staff. The manager wasn't going to interfere with something that he knew little about, and he was willing to take the advice of someone specifically trained to do that kind of work.

Swent: That's an interesting analogy, I think. Who were some of the people there at that time? Who was the manager?

Perry: Shortly after my arrival, the manager who had been there before the Anaconda takeover was replaced by Clyde E. Weed. He was a graduate of the College of Mining at Houghton (Michigan) and came out to Inspiration. He had, I believe, worked first as a superintendent at the Victoria Mine in Michigan and after some experience in Michigan was transferred to the Inspiration Copper Mining Company in Arizona. He was acquainted in some way with John D. Ryan, who at that time was Anaconda's chairman of the board and, while such a connection no doubt was helpful, Weed's rapid advance in the company was due essentially to his outstanding abilities.

He made a fine record at Inspiration; was there a relatively short time. He was quite young and, I believe, came to Cananea in his early thirties. He was decisive, vigorous, and very intelligent. He had an appreciation of geology, and I found him to be a great man to work with. He would listen attentively to my long-winded discourses on geology [chuckles], and often he would have no comment. Every once in a while, after a day or two of thought, he'd call me back and make what I thought were constructive comments on what I had been trying to explain to him. This was the kind of management that Anaconda had in those days. Of course, Clyde Weed moved up through the organization and was finally made chief executive officer of Anaconda.

Swent: So you had a long relationship with him, then, didn't you?

Perry: I had a long relationship with him, and I had a long relationship with another very fine mining engineer, Charles Brinckerhoff. Brinckerhoff was a fellow student at Columbia. While I was getting my master's degree, he was getting his degree in mining engineering. He came out to Arizona--unknown to me, incidentally. I was asked to go up to Inspiration to do a special job in connection with a fault problem that was facing the operation as

they tried to advance their block-cave mining to the west part of the ore body. I was mapping an undercut level below a caving stope and finding it very tough going, because the heavy timbering that supported the mine workings covered the rock exposure and made observations difficult. I heard a rustle in the manway almost below my feet. I thought there was a miner coming up, and this head poked through. I couldn't believe my eyes, but there was Charles Brinckerhoff. The last time I had seen him was at the Columbia University subway station, 116th Street and Broadway in New York City. [laughs]

Swent: He was working on this same project?

Perry: He was there as mine foreman, and had been working underground at Inspiration for several years. Later he was transferred to Chile by the Anaconda Company, and became manager of the Potrerillos operation. When the great expansion at Chuquibambilla took place--including a sulphide ore concentrator and a smelter plus a greatly enlarged pit operation--he was moved there as manager and after that was given the responsibility for all the South American operations of Anaconda. He was a first-class engineer and another example of Anaconda operators with whom geologists could work and have the satisfaction of knowing that their efforts were not only appreciated but applied to the immediate problems of mine operation as well as to exploration for new ore.

The Inspiration Mine, Arizona; Block Caving

Swent: Just to get it straight; Inspiration was underground at that time?

Perry: Inspiration was initially all underground. It was a block-cave operation adjoining the Miami Copper, which was the first of the great block-cave operations in the copper mining industry. Miami Copper was owned by Lewisohn Brothers, and its operation covered the easterly part of the Inspiration ore zone. The two companies worked well together. There were a few conflicts about the effect of caving on opposite sides of the property line, but they were generally settled in an amicable way. Techniques of block caving at Miami and at Inspiration were the same.

Swent: What were they?

Perry: Many techniques including position of draw points, the use of scrapers, haulage lay-outs, the study of the ground, the applicability of block caving to certain types of ore, how caving could be induced, whether the rock would be too hard to cave or too

soft and result in serious runs and overdrawing of chutes, and the role of faulting and displacement of the individual low-grade ore masses in relation to the plan for caving operations. Once you commit yourself to a caving operation, you've made a decision which is irrevocable. So it requires a great deal of experience and foresight along with some geological background to be sure that you don't commit yourself at the start to a thing that will result in a mining failure.

Swent: This is entirely different from mining operations at Butte. Is it because of the difference in ore bodies?

Perry: Exactly. At Inspiration the ore body consisted of a mass of disseminated low-grade ore that would run about seven-tenths to one and a half percent copper, whereas in Butte the miners were dealing with distinct and very restricted high-grade localizations of copper ore averaging five percent or higher, confined to vein fissuring and very often isolated occurrences due to small block faults that had cut off an ore body and offset it several feet or more.

Swent: So you were learning something different.

Perry: Very much so. It was excellent experience which I could apply to later work. And there were many low-grade prospects which came to our attention in later years which had to be appraised on the basis of whether they could be economically mined or not. After all, ore is something more than just a collection of minerals. It's something that can be mined at a profit. All economic factors must be put into the equation before deciding whether it's ore or waste.

The Study of Ore Genesis and Porphyry Intrusions

Swent: Was the situation at Cananea similar to Inspiration or was that different again?

Perry: No, again, that was different because Cananea had a large tonnage of very high-grade ore which was most economically mined by cut-and-fill and by top-slice methods. The ore body was localized within a breccia pipe, and this presented the intriguing possibility that further exploration would lead to more high-grade ore. It required using the same type of very fine detailed mapping that was practiced in Butte observing and recording the geology. At the same time, it offered an opportunity to do what might be called basic research on a very unusual geological occurrence, the

nature of which had not been seen or at least described in geological literature up to that time.

La Colorada provided an excellent example of the relation between ore deposits and igneous rocks. Ideas I've already mentioned that had been discussed at Columbia by Lindgren, Kemp, Spurr and others took on new meaning. For example, Spurr had been a strong advocate of direct relations between igneous rocks, their pegmatitic derivatives and the ore fluids. The field observations at La Colorada gave some support to Spurr's thesis. At the same time, La Colorada ore body was extremely unique as compared with Butte's veins, the high-grade limestone deposits of Bisbee, and the low-grade disseminated mineralization at Inspiration, all of which could be attributed to replacement processes. But all of them, including La Colorada, had close genetic affinity to quartz porphyry intrusives.

Swent: What were the tools that you were using? Were they microscopes?

Perry: The microscope was used for identification of rock types. Very often, where rocks were altered by later mineralization, it was difficult to identify them without microscopic study of texture and mineral distribution.

Wilbur Valentine, who received his doctor's degree at Columbia and was a student there shortly after my short period of graduate work, was asked to join our staff. He did a fine job of microscopic analysis of all the rock types at Cananea, mapping them in the field and identifying them under the microscope.

Swent: Where there other technological developments that helped at the time?

Perry: Not particularly, although there was increased interest in mining geology as indicated by more numerous publications reporting on important mining districts and also on expanding research activities. In 1933, the Sixteenth International Geological Congress convened in Washington, D. C. Numerous geological publications resulted from that meeting, including a volume on Copper Resources of the World. Many field trips were sponsored including one to Bisbee, Arizona, which was attended by Cananea geologists. I contributed a paper to the Copper Resources volume entitled, "Copper Deposits of the Cananea District"*. The American

*Vincent D. Perry, "Copper Deposits of the Cananea District, Sonora, Mexico," Copper Resources of the World Vol.1, p.413, Washington, D. C., 1935.

Institute of Mining Engineers produced the Lindgren volume on Ore Deposits of the Western States during that same period.

Swent: That was another point I wanted to ask about. This may be a little bit of a diversion, but what part did the professional organizations and conferences play in your continuing education and communication with other geologists?

Perry: I think they played an important part. I tried to keep up with all the publications available as a member of the AIME, Society of Economic Geologists, GSA and local organizations that had technical meetings.

Swent: I also wanted to know--what difference did it make to be operating in Mexico? Did this make a difference?

Perry: I didn't feel that it made a great deal of difference. Of course, we were about fifty miles from Bisbee, Arizona.

Swent: You mentioned that you didn't learn Spanish.

Perry: We didn't have to really learn Spanish. That was probably the reason I didn't become used to speaking Spanish, except miner's Spanish. I could speak and understand the Spanish that was used underground.

Swent: So it was not an Anaconda policy to make any concession to being in Mexico?

Perry: It depends on what you mean. Anaconda was alert to the political situation and maintained active political contacts in Mexico City. Locally there were general good relations between the Mexican and American communities. As an example of that good will, my wife, Margaret, was selected by a group of Cananea businessmen--all Mexicans--and honored at a dinner given by them in which she was formally crowned "Queen of Cananea". From a professional engineering viewpoint we were more in touch with the United States than with Mexico.

For example, we would attend AIME meetings in Bisbee or even in Tucson. We felt that we were part of the Southwest mining group, regardless of the position of the international line. Of course, the fact that Anaconda had an interest at Inspiration added to the close relationship. We were asked to spend time at Inspiration doing various jobs that the management requested from time to time. We visited other operations such as Ajo, Bisbee, Morenci, and Santa Rita. We were more or less part of a region where mining was being conducted on an active scale.

It's also true that our own special interest, geology, was not receiving the attention from other mining companies, such as Phelps Dodge and New Cornelia, that Anaconda gave it. But that didn't inhibit us in any way from getting out and participating in opportunities to visit these properties and see the interesting geological features that were unfolding in connection with the expansion of mining.

I still had my connections with Butte. I could go back, particularly in the summertime, with my wife and baby to Montana and see what was going on there. I was extremely fortunate to have opportunities like that. The breadth of my field was always expanding, largely because Anaconda itself was a growing organization, taking on more properties, and supporting geological activities. That's why I always admired Anaconda. I admired the men that ran it, because they believed in those kinds of things and were interested in science and were interested in doing more to promote the development of new ideas. They were creative leaders in that respect. I was fortunate to be able to work for such an outfit.

Living At Cananea##

Swent: I wanted to ask you a little bit about your living arrangements at Cananea, then, and how did you get there? You weren't flying back and forth between Cananea and Butte in those days.

Perry: No, in those days transportation was by train from Bisbee Junction to Los Angeles and then to Butte.

Swent: And company housing?

Perry: We had good company housing. It was not the most elaborate in the world, but it was typical of company housing. We had a nice house out on what we called "the flat" about five minutes from the number one tee on the golf course. So that to forget work and relax, it was always possible, after four or five in the afternoon, to go down and play a round of golf.

Swent: Did your wife enjoy golf?

Perry: Not particularly. We had a very competent criada who helped out with the housework. Like a typical foreign mining camp, there was a lot of social activity going on among our many friends, and we had fine picnics, parties and get-togethers on weekends.

Swent: Any association with Mexicans, socially?

Perry: Yes, of course, there was. We had some very close Mexican friends.

Swent: Were there Mexican staff members?

Perry: Yes, there were. But it was predominantly an American staff. There were highly competent Mexicans all through our organization. One of our finest geologists was Ruben Velasco, who was a Mexican citizen and a great contributor to the geological efforts in Cananea.

Swent: Where had he trained?

Perry: He was a graduate mining engineer from the University of Arizona. He became chief geologist at Cananea, and, after Mexicanization served as general secretary of the company. After his retirement he became professor of geology at the University of Sonora in Hermosillo. He is recognized today as one of the most respected senior members of the geological fraternity in Mexico.

There were other outstanding Mexican geologists that worked for the company. Among them, Ramon Ayala was chief geologist for several years. There were others who have either continued on in Cananea or have moved to other positions in the mining industry.

Swent: What about medical care?

Perry: We had an excellent hospital at Cananea, headed by Dr. Frank Hogeland, who was a graduate of the University of Pennsylvania and had early experience in Mexico during revolutionary times. He was the doctor at Minas Prietas during the days when Pancho Villa was rampant in Sonora and had many stories to tell about the conflicts with Villa.

Swent: Those days were fairly recent.

Perry: They spanned the period from 1910 to 1918. When peace was finally established under Calles in the twenties, Hogeland was engaged by the Cananea Company to be chief surgeon. He was largely responsible for building up a first-class hospital, a credit to his background as a graduate of the University of Pennsylvania, one of the outstanding medical schools of the United States. We had American nurses at the hospital.

Swent: Your baby, you said, was born in Inspiration.

Perry: [chuckles] Yes. At that time my wife had not resided in Cananea very long and we didn't appreciate the fact that there were

excellent medical facilities there. And since it was convenient for me to be at Inspiration to do a special geological mapping job that Inspiration Mining Company wanted done at that time, we went up there a short time before the expected arrival date and the baby was born at the Inspiration Hospital.

However, in retrospect, I can say that the quality of medical attention we received at Inspiration was no better and probably less than we would have received at Cananea. But that was a mistake which we made because of ignorance. We equated medicine in Mexico with something foreign and of questionable quality. We would have been better off if we had stayed at Cananea and had our baby there.

Swent: You might want to say something, because I think it is pertinent later, in Chile, also about the social life in the mining camps--the drinking and the hazards thereof, perhaps?

Perry: Well, that's quite a subject. [laughs]

Swent: I think it's worth touching on. Of course, right now, drinking is becoming out of fashion, I think, in lots of ways. But you went there in the flaming twenties, the late twenties.

Perry: Yes, and we went when Prohibition was creating all kinds of problems in the United States, and there were all sorts of abuses that stemmed directly from the Volstead Act. I went down to Cananea with little idea about social activities abroad. Our fun times in Butte were certainly good ones. We did, really, very little excessive drinking. I suppose there were times when somebody had too much to drink, but, generally, the parties were pretty orderly. We had a lot of fun in Butte.

Swent: What did you drink?

Perry: [laughs] Well, at Cananea some of it was "bathtub gin," although liquor was smuggled in from the United States and was also available from Mexico City.

Swent: Did you mix it with something?

Perry: Oh, we usually mixed it with fruit juice. I was in Cananea for some time before I had a drink. I remember the first real party we attended after my wife had recovered from her troubles following the birth of our baby, Pat, and had come back to Cananea with me. I remember at the time, I was surprised to find evidence of heavy drinking on the part of people that I didn't think took a drink. [laughs] Maybe the reason was that they weren't used to drinking.

Swent: What did they drink in Mexico? Was Mexican beer available?

Perry: Mexican beer was very popular, and, of course, they drank tequila and mescal, too. I didn't find that drinking was done in excess. There were times when people had too much to drink, but generally it would be on some very special occasion, like an AIME meeting over in Tucson, where there was a real festive mood, and there was sort of an escape atmosphere, getting away from local surroundings and across the international border into the United States. That alone was a cause for celebration, and occasionally somebody would have too much to drink.

Swent: It wasn't a problem with the wives?

Perry: No, although sometimes it is hard to draw the line. The wives generally set a high standard in Cananea. I thought it was, in many ways, an ideal mining camp. A lot of the things I had heard about life in mining camps simply didn't happen in Cananea.

For example, there were stories Helen Taylor wrote about social life at Chuquicamata, Chile. She had been a close friend of ours in Butte. She was a girl from New Jersey and married Al Taylor, an Anaconda geologist from Stanford University. As I mentioned previously, Al was given the job of organizing a geological department for Anaconda at Chuquicamata about the same time I was assigned the same kind of job at Cananea. Years later Al asked me if I had seen the book that his wife had written. I hadn't, and so he let me read it. In the book, Helen Taylor describes in somewhat startling detail some of the parties that went on in the American colony at Chuquicamata. It was kind of a shocker to me. I'm still not sure that Helen didn't exaggerate a bit, because that gave a little more color to her story.

Swent: I think we've all heard horror stories of Chuqui's parties.

Perry: Well, Helen Taylor tried to put it all in black and white. But this may be a case of how, sometimes, facts are exaggerated to make good stories out of them.

Swent: What did the women do for amusement in Cananea?

Perry: Well, there were several women who played good golf, and we had an excellent golf course. The women did a lot of golfing, and of course there were the usual rounds of bridge and that sort of thing. Some of them did a lot of good work around the hospital and helped, generally, in the community. Cananea had, really, a first-class group of mining people. They were recruited not only from Butte but from all over the country. That mixture from

different parts of the mining world produced a very healthy social atmosphere.

Swent: So those were good times to look back on?

Perry: They were times that I can't believe happened, they were so good. We were there ten full, happy years in Cananea, and the life there was one of hard work and lots of good, hard play in an ideal setting. You know, Cananea is beautifully situated. It's part of the southeasterly continuation of the basin-range topography. The San Jose Mountains rise to the northeast, the Ajos to the southeast, the Cananea Mountains and its extension, the Mariquita Mountain, to the northwest, and the Huachuca Mountains to the north. Between them extends a great, somewhat dissected plain, perhaps thirty or forty miles across, that gives a sense of openness. The elevation at five thousand feet is responsible for a relatively dry, invigorating climate, with moderate temperatures in the summer, a beautiful fall with cloudless blue sky, a mild winter, and breezy spring, so that from the standpoint of anyone interested in geology and getting out and mapping and working outdoors, it was an ideal environment.

Of course, the social life revolved around the golf course, and the get-togethers in the evenings when bridge would be the principal attraction, accompanied by good conversation. The ability to get in an automobile and go out across the line and be in the United States within two hours was a unique advantage.

Swent: What did you read? Did you take papers or magazines?

Perry: We read mostly the standard books of the time. Newspapers were rather scarce. We did try to get the Sunday Los Angeles Times; sometimes it was delivered, and sometimes it wasn't. But that didn't seem to bother us much.

Swent: Radio?

Perry: We had fair radio reception. It came in from Arizona stations, but it wasn't, of course, anything like the kind of reception you get today.

Swent: You were much more cut off then.

Perry: Yes, we were more cut off.

Swent: Movies? Were there movies?

Perry: There was a Mexican movie house, and I doubt that I attended it more than twice during the ten years I was there. If we wanted to

go to a good movie, it meant a special trip over to Bisbee to see the movie and then a drive back at night. Bisbee was close enough so that it provided access, if there were something really worth seeing. Otherwise, we were rather isolated and on our own.

We were a fortunate group of people to be located in Cananea in those days. I recall Reno Sales coming down on one of his periodic visits to check up on the geological work, and from the top of one of the Cananea mountain ridges, looking out over that expanse around us, fifty to a hundred miles in every direction, saying, "Vin, out of ten thousand mining geologists in the business today, you're probably the luckiest to have landed a job here." [laughs]

So that created a lot of happiness in our lives and in our family relations. We had a month's vacation every year, and we usually headed out to the coast to La Jolla, where we could enjoy the beach, or Santa Monica. Occasionally, we would get up to see my sisters and dad in Berkeley or, later, in San Francisco.

Swent: Did the Depression affect you? It affected Ananconda.

Perry: It affected Ananconda drastically, but at the same time, God, again was good to us, because we were mining a tremendous high-grade ore body, which was discovered just before the Depression started. Ananconda had the foresight to move in just before the Depression and acquired complete control of this rich source of low-cost copper. There was a long period where the price of copper was as low as five to six cents a pound, and yet Cananea was able to show a profit, even at the depressed copper market.

It was one of the two reasons why Anaconda survived the Depression. Butte was losing money. Anaconda was having a terrible time with operations there. The fabricating plants were losing money. Chuquicamata, which had been acquired in 1923, was a source of income even at low copper prices, and Cananea, with its bonanza ore body, was helping to keep Anaconda afloat. If it hadn't been for Chuquicamata and Cananea, Anaconda probably would have been in bankruptcy.

As a matter of fact, there are stories told about how Mr. Cornelius F. Kelley, the chairman of the board, went to the Chase Manhattan Bank and said, "These are the facts, gentlemen. We are unable to pay some of our bills. We do have producing mines at Cananea and Chuquicamata that are able to make copper at five cents a pound. Do you want to take over the operation, or shall we continue to run it?" And the bank wisely decided that they had better leave it in the hands of mining people who knew how to run mines, which is unlike the kind of thinking that occurred in much

more recent times when banks have moved in or greedy investors have tried to capitalize on situations where management temporarily has been unable to maintain a profitable operation.

Swent: So you were virtually untouched, then, personally, by the Depression?

Perry: Yes. Of course, financially, our salaries were cut in half. I remember that very vividly, but because we were living in Mexico and costs were low, it didn't hurt us too much. We were able to survive.

Swent: How much were you making at that time, do you remember?

Perry: I was making five hundred dollars a month, and my salary was cut to two hundred and fifty.

Swent: When was this?

Perry: At the start of the Depression, 1930, '31.

Swent: Just across the board.

Perry: Across the board, yes. Everybody was cut. But we accepted that. We were glad to have jobs. I suppose one of the reasons that we didn't panic under those conditions was the fact that across the border, Phelps Dodge at Bisbee, Arizona, Ajo, and Morenci was having a terrible time. It was laying off engineers right and left and curtailing their operations. We were fortunate to have a mine that was producing at 100 percent capacity, even though we had to take cuts in pay.

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Swent: But you could manage on two hundred fifty a month, with a wife and a child?

Perry: Yes, we lived a very satisfactory life.

Swent: It's hard to believe now. [chuckles]

Perry: It's hard to believe, but in those days, two hundred and fifty dollars in Mexico went a long way.

Swent: What was the exchange? Do you remember?

Perry: I believe it was two for one at that time.

Swent: And you were paid in--?

Perry: We were paid in dollars.

Swent: Deposited in the States.

Perry: Deposited in the States, yes.

Swent: Of course, you didn't pay a lot of tax.

Perry: We didn't pay any tax in the United States, and Mexican taxes were extremely low. I don't remember the exact amount, but there was practically no tax in Mexico. When you get that sort of money and are not subjected to a lot of taxation, it does very nicely.

Swent: And your house was provided?

Perry: We paid a nominal rent. I believe it was twenty pesos a month for our house. And food was very cheap. Of course, we didn't have a wide assortment to choose from, but the Mexican poultry and meat was a bargain. I remember we could get a tenderloin of beef for two pesos--the whole tenderloin. We had a refrigerator, and we could put that in the icebox and live off it for a week or two weeks. So those things made a big difference.

Swent: You didn't have to buy a lot of fancy clothes to go to work.

Perry: We didn't have any fancy clothes. We had our party suit, and that was it. [laughs] There were no fancy clothes.

Swent: Well, it was a good life.

Perry: It was certainly a wonderful life.

Swent: What did you do about schools and churches?

Perry: When we first went there, the Catholic church was banned in Mexico. Informal services were conducted by Mrs. Wiswall, who was the widow of Colonel Greene, the original settler and founder of Cananea, a big cattleman. She lived there in the home that they had built in the early days, and she was a devout Catholic. She tried to conduct a prayer service every Sunday, and we would attend that.

The restrictions on the Catholic church were lifted sometime during the thirties, and I don't know exactly when. But the Protestant community was served, again, by local people. There was a very fine neighbor of ours, Marion Keller, who conducted services in the Methodist church and had a Sunday school there. Our daughter attended Sunday school under her guidance in the Methodist church. We found that that sort of touch with religion was

helpful, and we did our best to make up for it with more formal services when we took our vacations in the United States.

Swent: Yes. This period in Mexico was a very interesting one.

Perry: It was, yes. And just about the time we left, the Catholic church was recognized in Mexico, and the old cathedral at Cananea was renovated. When I made periodic trips back to Cananea, it was revealing to see the devotion of Mexicans. As a matter of fact, during my last visit to Cananea in 1989, I was really surprised to attend a mass that was so crowded it was difficult to get in the church. The congregation was all Mexican, and the religious fervor of the community was as strong after the long suppression following the Mexican Revolution as it had been before.

Diamond Drilling Then and Now

Swent: I did want to ask also about your diamond drilling. Did Anaconda do their own, or did they contract?

Perry: No, we contracted the drilling, and our first contractor at Cananea was Jimmy Valenzano. Jimmy was a product of Butte. He was an Italian immigrant who went to Butte and started there as a diamond driller for the Anaconda Company. He then moved to Bisbee, first becoming a driller for Phelps Dodge, and then later formed his own drilling firm. The Cananea Company made a contract with him about the time I arrived there.

Swent: It's interesting, that the companies contracted this work.

Perry: Yes, but diamond drilling lends itself to contracting. It seems to me better results are obtained by contracting than by making it a company operation. It's a special field, where quality work is essential. Certainly, we had that in Valenzano. Phelps Dodge used him for all of their development in Bisbee and at Morenci. They were doing a lot of drilling, particularly towards the end of the thirties, when the Depression was ending, and they found that they were way behind in their exploration and development.

Swent: You supervised Valenzano's work?

Perry: Yes. Of course, we are talking about a period many years ago and since that time there have been many new developments in equipment and methods. The size of the drill cores and the high recovery of core are examples of how drilling techniques generally have improved.

Swent: What is the size now?

Perry: Well, we used to get an EX core, which was a 7/8-inch diameter core. We were lucky to get 75 or 80 percent recovery. Nowadays, if you can judge by the results that Atlantic Richfield obtained in Butte, recoveries of core that measured about four inches in diameter ran between 90 and 100 percent recovery--just remarkable. Of course, the cost of that type of drilling went up astronomically, too, but you did get results that could be depended upon because of those fine recovery figures.

Swent: What made the difference?

Perry: Oh, I'm not enough of an expert to offer an explanation, except possibly better design of diamond drill bits, better casing, quality of equipment and materials, as much as anything. Techniques seem to me to be much the same, as far as the general procedure around the drill rig is concerned. But the equipment is much better. I think that explains the better results.

Swent: So the modern geologist has a lot more information to work with.

Perry: Yes, but at a much higher price. We'll get around to that when we discuss these problems in Butte. Perhaps it's worth adding here, though, that in the twenties in Butte, when I was there, diamond drilling was seldom used because of poor results. The geological department rarely accepted results of diamond drill penetration because the core recovery was so poor, and you simply couldn't depend upon what you were looking at. Very often, if a hole was drilled and cut a vein, the alteration halo around the vein was soft granite. Perhaps the transition from very hard, fresh granite to the altered zone was rather sudden, and the driller couldn't catch that change fast enough to make his adjustment in the speed of the drilling or whatever other action would be appropriate in that kind of a situation. The net result would be that the core would be lost entirely, and you would have no sample at all.

Another example was the drilling that we did at Yerington, Nevada. We had great difficulty judging the reliability of diamond drill results from the discovery hole at Yerington--whether we had an ore body or not. We knew we had some good assays, but we didn't know how much salting had occurred. We tried to solve that by building a series of tanks around the drill rigs to catch all the material that came out of the hole, most of it ground-up sludge. We would assay that sludge and try to compare it, and we developed, in a sort of pragmatic way, formulae that we would apply to the recovery of sludge to weigh against the actual small pieces of core that were recovered, in order to provide at least a judgment of

what sort of material the diamond drill had penetrated. It was not a very satisfactory procedure.

The Anaconda management could not make the huge capital investment required for the Yerington project on such inadequate drill hole information. Therefore, an exploration shaft was sunk, crosscuts driven, and raises put up along each diamond drill hole, to check the validity of the drill results. Our guesses, and that's really, in a way, what they were, proved to be satisfactory and we went ahead with the Yerington development.

I think this was also true of Phelps Dodge's developments at Morenci. There was a long delay, and I do not know what caused it. There were perhaps other reasons, such as acquisition of water rights, but I know that Phelps Dodge hesitated a long time after drilling the great Clay ore body at Morenci before making the investment that created the biggest and best producer of copper in Arizona.

Producing Molybdenum from the Tailings

Swent: You haven't said much about molybdenum.

Perry: The molybdenum story, I think, is worth telling because it was a unique occurrence at La Colorada ore body. Here was this rich concentration of bornite, chalcopyrite, and chalcocite, but scattered all through it were flakes of molybdenite. As we went deeper in the ore pipe, the molybdenite increased at a remarkably consistent rate, and the bottom levels showed some high-grade molybdenite mixed with the copper ore.

When mining was started on La Colorada, there was no technique known about ways to separate the molybdenum from the copper. We had, I suppose, at the invitation of our metallurgical department, a visit from some of the metallurgists that worked at Climax, Colorado, which was then the largest molybdenum producer in the world. They did nothing but throw cold water on our talk about making the Cananea molybdenum an asset. I don't know whether it was for competitive reasons or not, but at least they were professional men, and I think they were honestly telling us that copper was a detriment to a molybdenum ore body and that you'd just better suffer along and get the copper out and not worry about the molybdenum. I know that the small amount of copper that occasionally occurred at Climax was a liability in their flotation process.

However, as an indirect result of an incident that occurred a short time later involving the geological department, our interest in molybdenum was revived. We had information that some high-grading and stealing of gold was going on in the Cananea mill. One day, Clyde Weed, the manager, called me up and said, "Have you any ideas about where that gold could be coming from? We hear reports that gold is being sold and that it's coming from the Colorado Mine. We don't have any free gold in that ore body."

And I said, "Well, are we sure we don't have any free gold?"

He said, "I don't think we do."

I talked it over with Roland Mulchay and after shift we went out to the tailings dam. We took a gold pan with us, and started panning the tailings that were coming from the mill. To our amazement, we found that there were strings of gold in those pans at least a finger long that showed that free gold was being produced at the mill, and the mill men didn't know it. [laughs]

Swent: A few of them had, maybe.

Perry: Well, maybe they had. So that was of great interest, but what interested us more, as geologists, was the fact that there was all this beautiful blue molybdenite coming out along with the gold. The recoveries of copper were very high. There was no sign of copper in the tailings. But here was gold, and molybdenite coming from the tailings after flotation treatment of the high-grade ore. So we reported our findings to Clyde Weed, and he said, "You know the Climax people have told us that there's no way of getting this molybdenite out of copper ore." And we, as geologists, suggested the common-sense idea that the tailings were showing these things were being separated and being produced, but not in the orthodox way. The molybdenite was not being recovered selectively; it was being lost selectively.

So we proposed to Mr. Weed that an effort be made to treat the tailings for molybdenum and gold. He accepted this idea and started metallurgical testing to recover these valuable accessory metals from the tailings. Roy Howe, assistant manager, and a professional metallurgist, did the test work. The tests showed that this was a logical way to proceed and a molybdenum treatment section was added to the concentrator. Cananea became a very important producer of molybdenite, and this was a surprise to the American Metal Company who up to that time had a monopoly on the molybdenum market. Cananea became a formidable competitor in the molybdenum business.

Later on, other companies, particularly Kennecott at Bingham Canyon, which had molybdenite in its ore, began to recover it. I don't know the metallurgical process used except that it involves selective flotation. Other large porphyry copper operations have added molybdenum recovery units to their mills and the recovery of molybdenum from copper ore has become a major source of molybdenum production throughout the world. But it is interesting to note the first production of molybdenum as a by-product of copper ores was at Cananea in the early thirties.

Swent: And you had something to do with it.

Perry: Well, as geologists, we did. We certainly didn't as metallurgists, because we didn't know anything about metallurgy. But it was just a common-sense approach that developed from the attempt to track down gold high-graders at the concentrator and, in so doing, the possibility of recovering by-product molybdenite was recognized.

Applied Geology and La Colorada Ore Body

Swent: Is there anything else we should say about Cananea?

Perry: Yes, there is something I would like to say about the geology of La Colorada ore body. I wrote a paper in the AIME Lindgren Volume published about 1933 and entitled, "Applied Geology at Cananea"*. It covered the geology of the district and emphasized application of Butte geological mapping to Cananea. La Colorada ore body received special treatment. Many years later I reworked the La Colorada data into my AIME Jackling Lecture.**

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Perry: Without going into details, the publication describes the ore body as pipe-like in form and closely associated with an intrusive plug of quartz monzonite porphyry. It has a cone shape with an outer shell of quartz laced with chalcopyrite molybdenite seams, an inner lining of massive chalcopyrite, bornite, chalcocite, and a core of brecciated porphyry containing large and small angular fragments of

*V.D. Perry, "Applied Geology at Cananea, Sonora," Ore Deposits of the Western States, Lindgren Volume AIME, New York 1933.

**V.D. Perry, "Significance of Mineralized Breccia Pipes," Jackling Lecture, Mining Engineering V. 57 p 367, 1961.

these same copper sulphides. The units funnel downward to a base of quartz, coarse grained phlogopite with intercrystallized copper sulfides and molybdenite. Careful mapping illustrates an orderly sequential arrangement and supports the idea of segregation from an original high temperature fluid assemblage. Where did these fluids come from, how were they trapped and released to form this cone of high-grade ore?

Drill holes deep below the bottom level of the mine and some further underground work below the bottom of the ore body reveal significant disseminated chalcopyrite within and around the porphyry intrusive. Along its northwesterly contact there is a broad zone of fragmented volcanics cemented within a porphyry matrix carrying a maximum of chalcopyrite disseminations. At shallower elevation along the northerly and northeasterly margins of the intrusive, but below the high grade, there is similar structure and mineralization, grading rapidly upward into the quartz root of the ore body. It demonstrates the copper and other accessory constituents of the cooling magma collected within a contact zone and spiraled upward into a cul-de-sac or blind alley under a roof of already crystallized porphyry where they were temporarily trapped and segregated. Under increased build-up of pressure, the confining roof of the trap ruptured and successive surges of the segregated mineral complex were injected into the fracture cone within the ruptured roof.

The close relation of igneous activity and mineralization as emphasized by Spurr during my student days at Columbia had strong support in the nature of the origin of La Colorada ore body. This is the kind of example that would be useful in exploring for other high-grade concentrations. There is the chance that further effort in this general direction of thinking can produce ideas that may be useful in searching for similar high-grade ore.

Swent: Would there be surface evidence of this?

Perry: The surface evidence may exist, or it may not. Over La Colorada, the surface evidence was minimal because this process had occurred at considerable depth and it more or less died out before it reached the present erosional surface. The one thing that the early surface mapping showed was that at the surface, which was generally iron-stained, just as many thousands of square feet around are iron-stained, there were thin, usually one-quarter inch to half-inch, quartz seams that ordinarily would be ignored in mapping procedures. I mapped each one of those little veinlets and put them all together on a map.

I was surprised to find that they formed a pattern, which was rudely circular in shape and, from a three-dimensional standpoint,

formed a ringlike outline above the underlying ore, the top of which was approximately a thousand feet below the surface. So those little quartz veinlets were telling us a story, and they fit in very neatly with the idea that they were an expression at surface of the underlying ore body.

An example where we tried to apply the idea was at an area called Sonora Hill. There we found the same kind of little quartz veinlets and they were mapped and the area drilled. We found a workable ore body, but it was low grade. We found considerable molybdenite associated with that ore. Again, we didn't find the high-grade concentration that we expected. However, in recent times during open-pit mining of this low-grade ore body, the operators uncovered a plum of very high-grade ore which probably represents the same type of segregation that may fit with the general progression of events which are so clearly illustrated at La Colorada.

While I was disappointed that we hadn't found something bigger or richer than the original model, still, I recall the wise remarks of Dr. Louis D. Ricketts, who, as I mentioned previously, was my mentor when I first started work at Cananea. He told me, "Don't be discouraged, Perry. Geology is a very complicated matter. I like to compare what happens in the earth's crust with the result of taking a deck of fifty-two cards and shuffling them up in various ways and the kinds of combinations that result from those shuffles. You're dealing with many combinations of geological factors, and they don't all fit together the same way each time. There will be differences. Be prepared for that." This was excellent geological advice from a very wise engineer.

Swent: So you're still working on the Cananea ore body yourself.

Perry: Yes, I have an interest, but since my retirement from Anaconda and the Mexicanization of Cananea, I have had little access to information about Cananea. In the spring of 1989 an exception occurred, and I was invited to make a trip there with Ruben Velasco and his wife, Alma. Roland Mulchay joined us for part of the visit. The management was very cordial and we had an opportunity to visit the large operating pit, other active workings, and to examine the surface geology of an interesting prospect immediately adjacent to the Cananea property. The last evening of my visit I was invited to give a talk at their local technical society and Velasco helped as an interpreter. I told them that they had better get to work and do more exploration, that there was a lot to be done in Cananea, that operating a huge open pit is economically sound when the price of copper is up and everything is normal in the copper industry, but the future is uncertain and they should be

looking for other concentrations of high-grade ore that would provide a more diverse backlog of reserves during hard times.

I don't know how much enthusiasm that resulted in. I don't think that the Mexican government is going to invest any money in looking for ore in Cananea, and I'm not sure about the private investors who recently acquired an equity. They are simply going to try to mine out what was developed there by the Cananea Company years and years ago. There are tremendous reserves of low grade in addition to the one huge rich plum of La Colorada high grade, which is now all mined out. They are working on that big pit, and they have an operation which, when the price of copper is up, makes money. In fact, when I was down there, they wouldn't give any figures, but I could assume that it was a profitable operation, at least from an operating viewpoint. The difficulty is that they have borrowed money from American banks to get to the point where they are so deeply in debt that the interest charges have simply become unbearable. Whether an operation can sustain that kind of financial burden is very questionable in my mind.

I think that right today, an American company operating like Phelps Dodge could take over the Cananea pit and really make it pay. I have no question that the Mexican engineers that are running it are equally competent and could make it pay if the operation was not burdened by tremendous overhead costs in Mexico City and interest charges to the banks in New York.

Swent: You mentioned an operation like Phelps Dodge. Did they operate in a different way?

Perry: They operated in a different way in the sense that they have financial integrity. They know how to do business and how to conduct an operation with due regard for the bottom line and the fact that you have to justify your investment at all times. The Mexicans have not done that. They've simply gone along with the viewpoint that you take over a mining operation that earlier investors and operators have created and then borrow more money when needed to strip additional ore reserves and replace wornout equipment.

Swent: I saw some maps here the other day. Are you still working?

Perry: Yes, I am not working at Cananea, but rather on some Butte problems. I am trying to use information on the deep drilling which Atlantic Richfield did in Butte and which revealed a lot of very important geological data that incidentally can tie into the concepts we've been talking about at Cananea: Where does this copper come from? How does the process evolve? Why do you have concentrations of high-grade ore in certain places? What are the

temperature and pressure controls? What role does structure play in the picture? I think it's a tremendous one, because structural control is the thing that decides the flow-path of mineralizing fluids, under varying conditions of temperature and pressures that existed as they migrated upward from their source.

Butte has a very important future and should be considered a great resource, even though it's produced so much copper in the past. It's a classic example of the relationship between igneous processes and mineralization processes. The early papers that Sales wrote about Butte, the work that Charles Meyer did there, and those that compiled the splendid work in the Graton-Sales volume of the AIME, have all contributed useful and stimulating ideas about the geological theory of ore formation.

Cananea, to me, is just a gigantic natural research laboratory where you can study these same things that exist in Butte. I was lucky enough to have worked in each district when so many underground workings were open. At Cananea they were being driven while I was there so I could go in and observe every day in this underground laboratory some new exposure and new development that might be applicable to the problems of ore genesis.

Swent: Of course, you didn't have to worry about pollution in those days, either, did you?

Perry: No, that's true. There was no concern about that, and the only time that I was really upset about it was one warm summer day. The geological office was fairly close to the smelter. The air was absolutely still, and the fumes of SO₂ (sulfur dioxide) were settling so thick over the office that you could hardly see across the road. I thought, "This is terrible stuff to be breathing."

So that evening I happened to meet the smelter superintendent, "Slats" Thurston, and I said to him, "That was terrible, the smoke up there at the plant. I can't understand how you metallurgists put up with working in that sort of an environment, much less spewing it out all over the landscape."

He said, "Vin, don't you know that sulfur is good for the blood?!" [laughter]

It certainly didn't affect me from a health standpoint, and the people in Cananea didn't seem to suffer from the smelter smoke, and that probably was because we didn't ordinarily have high concentrations of it. There was enough wind on those broad plains so the smelter smoke drifted off and was dissipated.

Nowadays, it's worthwhile to drive around Arizona and see the different plants and these modern new smelter stacks, with little or no smoke coming out of the top of any of them. Phelps Dodge has made a marvelous effort at recovering SO₂ from their smelter gases. I know Magma has and Inspiration has. I guess they're all living up to the very strict EPA [Environmental Protection Agency] standards on SO₂ emissions.

They've had to. It's part of the law. Across the border, in Cananea you can still see the smoke from the Cananea smelter spewing out in the air. They've done nothing to correct that in Mexico. There's been discussion about building a new smelter at Cananea, but I don't see how they're going to do it under current economic conditions.

As a matter of fact, part of the concentrate from Cananea is now being shipped to San Manuel in Arizona and put through the Magma plant. Even though Magma and Ray are close to Phoenix, a big population center, there's no sign today of any air pollution coming from those smelters. But it certainly does continue to come from the Cananea plant.

[Interview 3: March 9, 1990]##

Swent: When we stopped yesterday, we were about to leave Cananea but you suggested a couple of additional items to talk about.

Perry: Yes, I want to mention outside exploration activities. With the drop in metals prices during the Depression, gold became the only metal worth looking for. Mulchay and I made numerous examinations of gold prospects in Northern Sonora without any spectacular results. Our trips, often on horseback, provided good experience and took us to many isolated locations including the high plateau country of eastern Sonora, Baja California, and Sinaloa.

A Visit To Tayoltita, Mexico

Swent: Do you remember the names of any of the places in Sinaloa?

Perry: I don't recall their names now, but I was informed, passing through Mazatlan, that the single most important property operating successfully in that area was the San Luis Mining Company at Tayoltita. It happened that I had been a classmate of Larry Morel

who was, I believe, mine superintendent at the time at Tayoltita. So I got in touch with him and arranged a visit to the mine.

It was a real thriller for me, because I had never gone into such rough country on a plane, and the flight into that narrow canyon and landing on the tailings dump at Tayoltita was something to really impress the outside visitor. I met the manager at the mill, and arrangements were made to go on muleback up to the mine, where I arrived about midday. Larry immediately got me underground, because I told him I had to be back in Mazatlan the following morning, and we had a great trip through the mine. It was the first time I had ever seen a really rich silver property. To this day, I remember going in one of those big shrinkage stopes. The ground was hard, and there was no timber to interfere with the geologist's views. You could look along the back of that stope as far as your light would flash, across widths of probably ten to thirty feet. The quartz vein was simply ribbed with reddish traces of very high-grade ruby silver mineral. I couldn't believe that anybody could be so lucky to have such a rich mine right there at their fingertips and able to knock the rich ore down with such ease.

We had a wonderful visit through the mine and got out about six o'clock in the evening and found that Larry's wife had already cooked up a big party for that night. So we spent the rest of the night celebrating, and about two o'clock in the morning, I reminded Larry that I had to take the plane out of Tayoltita at around five or six o'clock in the morning, and he'd better get me down over that trail. [chuckles] He got a couple of mules. Phil Chase, one of the Tayoltita geologists, was there, and he said he'd go down with me. They practically strapped us on the mules, and we started down that dark, black trail, largely depending upon the intelligence of the mules to get us where we wanted to go. [laughter]

We arrived on time and took the plane, and I guess the thrill of taking off from that tailings pile was about the same as the juvenile flyer has when he makes his first trip off the deck of an aircraft carrier. You reach the end of the tailings pile before you're airborne, and, as the wheels leave the embankment of the tailings, the plane sinks down into the canyon. I wondered whether it was ever going to catch enough air to actually become air-borne, which it finally did. They were very skillful pilots, and they maneuvered the canyon without any difficulty. But it was a thrill for me.

Swent: Do you happen to remember what kind of plane they were using at that time?

Perry: I believe it was a tri-motor Ford. But I may be wrong about that. It was a rather large plane, I thought, for that kind of use. But it did carry cargo, and probably the mine needed that sort of transportation facility to handle the kinds of loads that served the operation. It was certainly more than just a passenger plane. But it was a real thrill, and it colored my judgment a bit when I subsequently looked at other properties along the same mineral belt in southeastern Sinaloa and wondered whether any of them would be rich enough and productive enough to stand the sort of capital investments that were required to originally start the San Luis operation. That was an exceptional bonanza, and I don't think anything like it has been found in that same area.

Swent: Not yet, anyway.

Perry: Not yet, no. Well, it must have been very evident to the early-day prospectors. It again reflects the intelligence and skill of the Hearst interests in those early days when they could move around the country and pick up bonanzas like San Luis in Mexico, and in the same period have a representative in Utah discovering and developing the very rich Ontario vein, and then moving on to Lead, South Dakota, and acquiring the fabulous Homestake Mine. At the same time, the syndicate of Hearst, Haggin, and Tevis financed Marcus Daly's spectacular development of the Ananconda operations in Montana. They were a very smart, well-organized mining group--very aggressive, enterprising men. Their motivations, of course, were to own everything that was rich and good in the newly-opened West. They pretty nearly succeeded. [laughs]



Vincent Perry with daughter Patricia and wife Margaret sailing for South America on the Santa Cecilia of the Grace Line. January 20, 1950.

IV EXPLORATION GEOLOGIST, 1937-1939

Swent: So then you went back to Cananea?

Perry: We continued working at Cananea until 1935. At that time, there was the first of a series of serious labor disputes and the mines shut down. Most the of the American families left camp because of the uncertainty of the situation. I took my wife and daughter to Berkeley to be with my sisters. Reno Sales gave me an assignment on outside exploration in the United States.

He had certain examination jobs planned and asked me to join Frank Cameron, who was then doing exploration work for Anaconda in Alaska, with headquarters in Seattle. Cameron came down to California and we met at Grass Valley. We made several examinations along the Mother Lode, visited prospects in the Mojave Desert and made a trip to central Nevada.

I received word from Mr. Weed that the Cananea strike had been settled and a project had been approved to resume exploration work at the mines. So we returned, although with some reluctance, because Margaret had started our little daughter in the Berkeley schools.

The Move to Hollywood, California

Perry: We remained in Cananea for a short period and then in the spring of 1937 I asked Sales if there might be an opportunity to return to the United States. Sales said that he was willing to establish an outside geological office in the United States and to have me continue the work that I had been doing when I was in the temporary job, with Cameron, in the United States. I asked him where he planned to establish an exploration office, and he said, "You just pick your place. Pick a place where you and your wife and child will be comfortable, and give your daughter a chance to get a good

education." The education problem was one that concerned us all because, while Cananea had a multi-national school, supported by the company and with excellent teachers, it was restricted to elementary grades and its graduates had to be sent to the United States for their continuing high school studies. Therefore, Margaret and I decided to move to the Los Angeles area. I suppose there was a touch of glamor involved in it, but Hollywood seemed to be the preferred spot.

We found an apartment on Hayworth close to Hollywood Boulevard not far from the home of Dr. Hogeland's wife, who had been a friend of ours in Cananea and who had brought her daughter to Los Angeles to attend school. She had an apartment at Westwood. Mrs. Kirk, widow of a former Cananea mine superintendent, and her daughter were living in Hollywood also. Mrs. Wiswall, the widow of Colonel Greene who had founded the Greene Cananea Mines and the Greene Cattle Company, was living at the intersection of Hollywood Boulevard and Hayworth. So it was a nice neighborhood to be in, and my wife, I could see, would be very happy there with the friends she had already made in Cananea. There was an excellent school within a block. It was a parochial school, St. Ambrose, so we started our daughter in school there.

Exploration in Arizona

Perry: I took off for the desert and left my family in Hollywood. We were separated a good part of the time because I was in the field almost entirely for the next two years. I started work on prospects in Arizona that Mulchay and I had read about while researching available publications and reports. One of the sources of information that was most valuable was a series of reports that had been written by two mine geologists named Beckwith and Spilsbury who had worked for the Inspiration Consolidated Copper Company. Because of the interrelation through Anaconda of Inspiration and Cananea, we had access to those reports.

We made a thorough analysis of all of the material available in the files and picked out several that sounded rather interesting. One of Mulchay's ideas, and I think it was an excellent one, was that any of the prospects described in the reports and located in the Arizona desert that showed some evidence of contact metamorphic mineralization in limestone would be something to investigate, because the contact zones produced hard garnet, which weathered differentially and, therefore, stood out above the desert wash. Around those outcrops, the softer

porphyries or volcanic or sedimentary rocks would generally erode, so that it was likely that if there were mineralized zones of which the contact metamorphic part outcropped, associated with those would be areas of more widespread mineralization that would be hidden by gravel cover, because they were soft and had eroded more readily. I used that as a general field guide and looked at several of those occurrences.

One of them was the district immediately south of Tucson including Mineral Hill, Helvetia, and Twin Buttes. I optioned ground there and did a small amount of drilling but did not find anything that at that moment appeared important enough to go ahead and develop. It was probably a case of not following through aggressively, and part of it was the fact that we were limited as to the amount of money we could spend. In these days of multimillion-dollar exploration budgets, it's rather interesting to reflect back that our budgets usually were in the order of ten or fifteen thousand dollars. When we couldn't produce an ore body with one or two drill holes, it was time for us to move on to some other locality.

If we had stayed with that area, I feel confident we would have discovered then what later became a very important development after United Geophysical had found a small high-grade ore body at Mineral Hill and had acquired a lot of surrounding ground, which attracted the interest of several major companies, including American Smelting and Refining Company, Cyprus, and others. Of course, we knew, and this was twenty years after our early efforts there, that in the light of the new discoveries there were other possibilities, and so capitalizing on at least that old information, we were able to secure for Anaconda a large part of the area which embraced the old Twin Buttes Mine--again, small, isolated, contact metamorphic showings that outcropped through the desert wash but around which there was concealed widespread low-grade mineralization in sedimentary rocks and in porphyry intrusions.

Swent: These were going back to copper?

Perry: They were going back to copper, yes.

Swent: And you had been looking for gold?

Perry: We had been looking for base metals, and for precious metals. The price of gold had been raised by the Roosevelt administration from twenty dollars an ounce to thirty-five dollars an ounce. But as we approached the end of the thirties, it became increasingly evident that trouble was brewing in Europe, and the economic interest in metals began to swing away from the precious metals to the base

metals, a fact that was reflected in increased prices for various metals, particularly copper.

Swent: This sort of judgment--where was this made? In the head office?

Perry: No, I don't think so. I think the company was so preoccupied with Chile and their ownership of tremendous reserves at Chuquicamata and felt that if there was going to be, and I'm quite sure they anticipated, a strong copper market, that they had enough copper in Chile to satisfy any conceivable demand that would be put upon their copper-fabricating capacity, particularly since they owned the American Brass Company and the Anaconda Wire and Cable Company, two of the largest consumers of metal in the United States. My very minuscule efforts to find copper in the Southwest United States was of no great primary importance. I had the sympathy and the attention of my immediate superior, Reno Sales, but I think his position of authority as far as determining company policy was restricted, too.

Swent: So you could look for any metal that you wanted to look for?

Perry: Yes, and I was on my own. I was following that dictum, "Just go out and find a mine." Of course, I was looking for things as rich as San Luis Mine in Sinaloa, that type of thing, and they are not easy to find. [chuckles]

Disappointments in Coordinating With Company Policy

Swent: Did you have any chance to argue for one of these finds? I know you were disappointed.

Perry: Several situations involved lack of coordination between the field work I was doing and company policy. An example of this is the frustrating experience I had at Morenci. In connection with my studies of the Southwest generally I was very much impressed with the great Morenci district, and I knew that Phelps Dodge was supposed to own the whole district. However, as a matter of curiosity, I went around the outskirts of the district, and was surprised to note that there was a lot of ground that Phelps Dodge did not own. So, on my own, I secured an option on a large tract of ground covering the west part of Morenci. In my reconnaissance, I also noted an unusual breccia pipe outcrop immediately north of the ground I had optioned and adjoining property covering Phelps Dodge's newly drilled out Clay ore body, which is the central mineralized core of the Morenci Mines.

I visited the county clerk's office, and looking at the property maps I found out that this mineralized breccia was not owned by Phelps Dodge. It was owned by an individual whose name was in the phone book, and I looked him up. He told me, "Yes, I own this ground."

I said, "For whom do you work?"

He said, "I am an employee of Phelps Dodge. I am a clerk in their office."

I said, "Why hasn't Phelps Dodge purchased this ground from you?"

He said, "They're probably holding out to get it for nothing."

I said, "Well, would you be willing to talk to me tomorrow morning about it?"

He said, "Oh, yes, I'd be glad to."

So, after a very brief talk, I convinced him that for a down payment of a few hundred dollars I could have an option on the ground. I hired a local attorney, the expenses for the attorney coming out of my limited expense account, and I had this thing tied up for Anaconda. I was delighted to have made such a find. I thought that here I had a prospect with great possibilities adjoining a proven mine.

Reno Sales came down at my request to see this new prospect. He expressed some chagrin and said he would have to find out--get some instructions from New York. He called Cornelius Kelley and told him that one of the Anaconda geologists had located a block of ground that showed interesting mineralization adjoining the important developments Phelps Dodge had been making recently in that same area and where Phelps Dodge was planning a major new open pit mine. Kelley was rather shocked at this news and said, "I'm sorry, Reno, but I'm afraid we can't follow this. I've already made a commitment that puts Anaconda in a very difficult position. I have an agreement worked out with Mr. Cates, chairman of the board of Phelps Dodge, by which Anaconda will provide certain engineering services to Phelps Dodge in designing and building the concentrator and smelter for the Morenci project."

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Perry: He said, "It would be certainly inconsistent for Anaconda to move in competitively and try to pick up mineral ground after already

making a business arrangement and contract with Phelps Dodge to help them in the exploitation of their Morenci deposit."

The net result was that I turned the options back to the landowner and Phelps Dodge, of course, has since acquired all that land, and it's now part of the big Morenci open pit. [laughs]

Swent: That must have been a big disappointment to you.

Perry: That was a terrible disappointment, but it taught me I should be a little less aggressive in moving in before I had checked with my superiors and found out whether my objectives were consistent with company policy.

The next move I made, though, that again put me at cross purposes with policy in the New York office, was to examine and recommend three large separate deposits, the Castle Dome near Globe, Miami; the Louis d'Or, in the same general district; and the Bagdad deposits. Mulchay and I had made an earlier examination of Bagdad in 1933. These all had evidence of extensive low-grade copper mineralization, outcropping at the surface. Drilling had been done by promoters and owners, enough so that, in my judgment, they looked as though they had the makings of future mines. At that time Bagdad was an operating mine. I reported favorably on them, and again the New York office turned me down on the basis that material of such low grade was not attractive to Anaconda. I suppose their judgment at that time was a reasonable one, because they were opening up such large, good-grade deposits in Chile, specifically, Potrerillos and Chuquicamata, so that these six- and seven-tenths percent copper grades that I was talking about simply didn't look as though they measured up competitively with the kind of things that were available in Chile.

So I was turned down there, and I continued my efforts and found a very interesting low-grade porphyry extension of the old Silver Bell District, a contact metamorphic limestone deposit which was located west of Tucson.

Swent: Excuse me. May I ask just one question? You had mentioned limestone. Was this the first time that you had been working in limestone?

Perry: Well, the Cananea District was a beautiful type locality for all these rock types and it contained an important limestone section. The limestone was covered, unconformably, by volcanic rocks. These host rocks, in turn, were penetrated by deep-seated intrusives including a series of quartz-porphyry plugs. The Cananea sequence is typical of the general pattern that exists in so many of the big copper districts of the western hemisphere.

Swent: Is there limestone at Butte, also?

Perry: There is no limestone in Butte. Butte has a granite wall rock, but again it has an important quartz-porphyry intrusive.

It's those quartz-porphyry intrusives which are the genetic keys to the copper mineralization. But the limestone occurrences, where they were affected by contact metamorphism, provided surface indicators for centers of mineralization.

Swent: So, now, let's go back to Silver Bell.

Perry: Well, Silver Bell was another of those occurrences with a contact metamorphic zone. We found extensive mineralization in porphyritic rocks away from the limestone center. I recommended this to the company. Ownership was in the hands of a group in Boston and I hoped that, through financial or personal contacts, our people in New York had enough influence so that they could tie up the ground I was recommending.

American Smelting and Refining Company, which owned the small contact metamorphic part of the district, had apparently gotten word of my activities in trying to tie up the whole district. While New York and Boston were considering what to do about my proposal, American Smelting and Refining Company acquired all the ground I was interested in. It has become one of their big mines in the Southwest.

In reflecting on these things, it's evident now that my efforts were not properly coordinated with the overall company direction from the head office in New York City. I was simply a member of the geological organization well down the ladder who was given an order and, I assume, was not expected to find very much, but at least I was given a chance to go out and look the country over. The general idea seemed to be: "Let this young fellow roam around a bit and see what he comes up with." But this isn't the way to find mines.

The way to find mines is to have an organization, to have a team, to have legal help, to have men competent to go out and negotiate for properties, and to have operators that can be brought in to do the necessary drilling and underground development to determine whether there is enough ore there to justify the large capital investment required to make a mine. In those days of the thirties, there was plenty of technical talent at the various company operations engaged in production but not in the search for new mines.

What Anaconda did have was a fabulous ore reserve located in Chile and we were committed to a big investment there. There was nothing wrong with that except for one underlying long-range weakness, an overriding political problem, which the company hoped would never come to a head, namely that a Communist such as Allende and his group would take over the reins of government. We should have been looking for the kind of low-grade deposits in the United States that would have at least sustained requirements of Anaconda's copper and brass fabricating if the foreign mines were expropriated.

Swent: Of course, even before Allende, the war must have interfered with production.

Perry: No, it did not. Shipments were under a certain amount of hazard because of German submarine activity, but the U. S. government was completely aware of the strategic importance of Chilean copper, and maintained military establishments along that west coast and through the Panama Canal so there were no incidents of actual conflict that interrupted the flow of copper.

There were periods when supplies of copper built up on the docks at Antofagasta, when shipments were temporarily held up. The first trip I made to Chile in 1944, I saw firsthand what two or three city blocks of copper ingot looked like, stacked up one on top of the other as far as the eye could see. They were shipments that were being held temporarily because of fear of German submarines. But the copper generally moved, and it was received in the plants in Connecticut, and other places in the eastern United States, and fabricated into war materials or whatever use for which the copper was designed.

Transfer to Salt Lake City, 1939

Swent: We still have you in Los Angeles.

Perry: Well, after these frustrating experiences which I have been relating, and which covered a period of over two years, Sales decided that something had to be done to establish a better rapport between exploration effort in the United States and the overall policy of the New York office, which was focused almost entirely on developments in Chile. So he suggested that I move and become part of the Salt Lake City organization, which had existed for some time but which was used primarily as a means of developing a supply of metal, principally lead and zinc, for the Tooele plant. The Tooele

smelter at Tooele, Salt Lake City, was owned by Anaconda and had a lead-zinc unit and also a copper smelter.

Swent: This was a refining plant?

Perry: It was a complicated metallurgical plant designed to treat complex copper, lead and zinc ores.

Swent: And were there mines?

Perry: It was designed to handle custom ore, although the Anaconda Company did have some small properties which were served by the metallurgical facilities at Tooele.

Mountain City Copper, Nevada

Perry: One of the most important was the Mountain City Copper Company, and I suppose the event that precipitated my move from Los Angeles to Salt Lake was the assignment to carefully map a newly-discovered high-grade copper deposit at Mountain City. This was an extremely interesting, unique occurrence. It was found in the Old Mountain City district, which was a gold camp, by a practical prospector named Hunt.

Frank Hunt had spent his life looking for mines in Nevada and towards the end of his life had found what he thought was a really attractive outcrop in the Mountain City district. It was a gossan about fifty to a hundred feet wide and approximately three or four thousand feet long that contained, in addition to the iron oxide, a lot of quartz. There were no particular values in the gossan. It was thoroughly leached but Hunt correctly surmised, with only his own practical experience (no technical knowledge at all), that underneath such a gossan there could be an enriched copper zone. He studied the old drainage at Mountain City and decided where the water table should be and, with a partner, in the winter of 1937, sank a winze 208 feet to this projected water table. How he ever sank that winze in the dead of winter with the temperature reaching down to thirty and forty below zero, I don't know. It's said that he kept a good supply of whiskey on hand and that that fueled his efforts to get the winze down. At any rate, by spring, he had reached the projected 208 feet, and at that top of the water table the barren gossan went into massive high-grade copper ore.

Swent: Just where he said it was?

Perry: Just where he said it was going to be. He came into Salt Lake City. He had met Reno Sales, and said he didn't have much use for geologists, but he said Reno Sales was the exception; he was a geologist who really understood geology, and he wanted to show him his sample. Reno Sales happened to be in Salt Lake City at the time, and he had a nice, friendly talk with Hunt. Hunt invited him to come out and see the development. Sales made the trip out in a wagon from Elko, a distance of about a hundred miles, and he confirmed the size and richness of the discovery. Across a width of about fifty feet his lowest sample ran 38 percent copper. [laughs]

Swent: Oh, my!

Perry: So a deal was made with Hunt. He was paid a substantial sum of money and the property was turned over to Anaconda which operated the mine successfully for several years. I was asked to map and study the geology. It was an interesting and stimulating job, and it took me away from the phobias that had begun to develop looking at six-tenths and seven-tenths disseminated copper in subeconomic porphyries in Arizona. [chuckles] So Sales said, "Why don't you just move the family up to Salt Lake City--it's a nice place to live--and work out of there?" That was an excellent suggestion, and I moved in September 1939 and established my headquarters in Salt Lake City. I became part of the Salt Lake City geological organizaion.

V CHIEF GEOLOGIST OF THE ANACONDA COMPANY, 1949

Swent: What was your title?

Perry: Well, for a while I didn't have any title, and then, finally, when Tom Lyon, who was chief geologist of the International Smelting and Refining Company, retired, I was given his title. In 1949 when Sales retired, I was given his title as chief geologist of the Anaconda Company.

So I maintained my headquarters in Salt Lake City, and about that time the New York office decided that I should have my headquarters in New York City. I politely refused to go back to New York, because I didn't want to have any part of living in a great, big overwhelming metropolis when I had such a delightful site in Salt Lake City with many friends, and out West in a place where the mines are, and where I felt I could really do something useful.

In the meantime, the problems in South America became more and more acute, and I was called upon to go down to South America periodically. Mr. Weed, who by then had become chief executive officer of the company and who had been my manager at Cananea, said, "Vin, you just have to get here to New York if we're going to have an organization that functions properly with mine operations and geological work integrated."

After much deliberation, we moved to New York in 1956. But that was really a move which I didn't like to make, and there are regrets to this day that I didn't stay in the West where I really belonged and where I felt I could do some good. I was certainly not cut out to be a financial man or a New York administrator or executive. I felt much more at home with the mining people in the West and with the opportunity to get out and be in the mines and around mining men, where I had some understanding and sympathetic friends that would be helpful when I needed them.

Swent: You were in Salt Lake for seventeen years?

Perry: We were in Salt Lake for seventeen years, from '39 through '56, yes.

Swent: When you first went there, you were just in charge of exploration in the States?

Perry: That was about the size of it, yes, without any particular title. I was just the exploration geologist, and the whole thing was an informal effort. There was no organized group. I did my job, and when I needed geological help, I would call upon one or more of the operating geologists, usually in Salt Lake City or, if I needed them, in Butte.

One of the things that I did try to do was set up some branch offices after our efforts became more extended. One of them, particularly, was the office in Reno, Nevada. I staffed that with Bob Moehlman, who was a Butte geologist that had received his doctor's degree at Harvard. He was helpful as an assistant on two projects, the first being the Battle Mountain Nevada development, which was initiated about that time. We took over the entire Battle Mountain District where interesting copper discoveries had been made and also some gold showings, and built a small mill to treat the limited copper-gold reserves that had been blocked out.

Yerington, Nevada

Perry: The other important development, and it proved to be a very major development in later years, was the exploration at Yerington, Nevada, south of Reno. Yerington was an old district. It had been developed by Thompson, who was later active in founding the Newmont Company. He had built a smelter at Yerington but some time during the early part of the century, the whole operation had come to an end and the smelter had been dismantled. Sales told me something about the history of that development, because he had made a trip there in those early days. He said, "Vin, you ought to look that situation over very carefully. In my opinion, there are geological indications that there may be something more important than anything that was found by Thompson and Newmont." So I made a cursory examination and then asked Moehlman to map the whole district in detail.

Moehlman's mapping revealed a very important thing--that, while a large part of the area extending from the Walker River up to the Singatse Range, a distance of about two miles, was covered completely by alluvial gravel--that poking out at one point beyond



Left to right: Vincent Perry, Reno Sales, and Alex McDonald.
Examining outcrops of Yerington District, Nevada. Circa 1948.

the edge of the alluvial fan, there was a very interesting outcrop of quartz porphyry, well mineralized with copper oxides. Surface samples take by Moehlman showed that these outcrops ran between 1 and 2 percent copper. We studied this particular showing in relation to the geology of the whole area and came to the conclusion that there was a good chance an extension might extend under the gravel cover. So a drill site was selected several hundred feet from the original outcrop and drilling was started through the gravel. The first hole made an important discovery of 2 percent copper sulfide mineralization immediately below a thin layer of copper oxide mineralization.

I, of course, was excited about the copper values found in the drill hole and reported them to Sales and to Clyde Weed in New York. Weed made a trip out to see what I was talking about. We stood at the edge of the copper-stained outcrop, and I showed him where the drill hole was located. Pointing westward towards the Singatse Mountain Range I said, "You know, Clyde, there are two miles between us and those mountains that are entirely covered. There could be a lot of copper under an area of that magnitude."

He said, "Yes, Vin, that may be, but what are you going to do about this river in back of you?" The West Walker River was flowing within a few hundred yards of where we were standing, and he said, "I can't imagine trying to mine under a flow of water like that."

And I said, "Well, Clyde, modern equipment is such that --"

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Swent: Let me get this straight. These alluvial fans were coming down from a mountain to the west?

Perry: To the west of us.

Swent: And the Walker River was --

Perry: Immediately to the east of us. In other words, we were on the westerly gravel-covered flank of the Walker River Valley. Yerington is the farming community in the center of the valley, a very rich little area of farms and ranches.

Swent: And Mr. Weed didn't think that you could mine under a river?

Perry: Well, he was concerned about mining adjacent to a river and under gravels that were saturated by a water table directly related to that river. He certainly had a point. Another of the very questionable matters was that this fine showing of 2 percent copper

was largely based upon sludge samples. The rock was so badly broken that core recovery was negligible, and we didn't have sample information upon which we could rely. So we decided the first thing to do was to get more drilling done, and moved in a churn drill and another diamond drill. After putting down several holes, it was evident that there were economic thicknesses of both oxide ore and underlying good grade sulfide mineralization. So I then suggested to New York that, instead of depending on the drill holes, where the recoveries were simply unsatisfactory, we had to get down and sink a shaft and do some underground work to confirm what the drill holes had indicated. Not only that--by sinking the shaft I could perhaps answer Mr. Weed's fears about the water problem. If we could handle water in an underground operation, certainly it could be handled in an open pit. So I asked --

Swent: You were intending an open pit?

Perry: We were intending an open pit, because this was shallow ore.

Swent: So your shaft was only for exploration?

Perry: For exploration.

I asked that Alex McDonald, who I've mentioned before--he was the best man at my wedding and a close friend in the early days in Butte and had done fine work there during the Depression in administering the company's efforts to feed and house people that were destitute because of tough times in Butte. Alex had, in the meantime, gone into operations and was managing the Mayflower Mine for the Anaconda Company in Montana. The Mayflower was a very high-grade gold mine. It was a small operation, but it was being run efficiently and showing high profits under McDonald's management. I asked the management in Butte if they could spare McDonald and have him come down to Yerington and develop a mine for me. [chuckles] Reluctantly, they agreed, and McDonald was transferred from the Mayflower Mine under the Butte operation to the geological department at Yerington.

Alex sized the situation up, and immediately devised a very practical, sensible plan. He said, "Let's drill four big churn drill holes, one on each corner of the proposed shaft, put deep well pumps on those holes, and just pump for all it's worth to see how far we can drop this water table, which is being fed by the nearby Walker River." Alex went ahead with this program, pumping many thousands of gallons of water a minute from each of the holes, and he was able to draw the water down. He said, "If I can keep those pumps going and keep that water down, we can sink a shaft and follow the water table as we gradually reduce it by pumping from the wells."

Swent: What did you do with the water that you pumped?

Perry: It went back downstream into the Walker River. Of course, it was good water and had no evident impurities. So the water problem was tackled in that way, and a shaft crew from Butte was sent down. A two-compartment exploration shaft was sunk to about three hundred feet under this head of water. Levels were turned off at the center of the oxide zone and within the sulfide zone. Crosscuts were made on each level and connected with the exploration drill holes, and raises were then put up on various drill holes so that we had an excellent check on grade by putting all the material that came out of each of those raises through a small sample mill. The net result was that we knew we had a proven ore reserve and that this would be a mineable deposit.

About the same time, there were concerns in Washington, D. C., about the deteriorating political problem in Korea. It became increasingly evident that copper was going to be needed for another war period, so Washington was interested. Anaconda negotiated with the War Production Board to get accelerated depreciation to bring this deposit in rapidly.

Weed selected Bert Millar, who was an operator at Cananea, to design the pit, and picked Wilbur Jurden as the engineer to design the concentrator and the leaching plant. The idea was to leach the oxide ores, and precipitate the soluble copper, and to concentrate the low-grade sulfide, and ship the concentrates to Anaconda. This was a real disappointment to my friend, Alex McDonald, who wanted to continue as manager of the operation. I suppose this is one of the things that happens in a mining organization. It was Weed's judgment that Millar, a man with a lot of background and experience in open-pit mining, would be better than McDonald at this sort of job.

I'm not sure that was right, but at any rate it was a break for me because McDonald was assigned to me as my assistant and I moved him to my Salt Lake City office. We worked very closely together for the next few years in a lot of different mine examinations and exploration jobs.

Choosing Assistants: Requirements of a Mining Geologist

Swent: I wanted to ask about choosing your assistants. How did you go about choosing the people that worked for you? Did you have authority to hire them? What were you looking for in them?

Perry: I was looking for men of intelligence, number one, but I also wanted men who were not only well-educated, experienced, and practical; but also men who were loyal, trustworthy, and of solid, sound character.

I had met so many good geologists in my first few years in Butte, Montana, that I naturally gravitated towards them, so that some of my selections were men that I had known and that I obtained from the Butte department. They had already been through the training that was offered in Butte, which, as I have mentioned was considered by the mining fraternity as a graduate school for mining geologists. A lot of fine men wanted to go to Butte simply to get that experience and training background.

So I was fortunate in being able to pick men of that caliber and to have access to that kind of a supply of talent. I wanted men with good educational credentials and also ones of good character. I was certainly anxious to get men who were hard workers in the field because it was the field work that counted. That's where the facts were, and that's where we wanted men that could observe them accurately, record them properly, and analyze them correctly.

Swent: Did you ever go outside the Anaconda organization for people?

Perry: Not very often, but there were a few cases that we will discuss later. For example, Jack Knaebel and Glenn Waterman, and others that Knaebel brought into the company, had worked for other companies before becoming Anaconda employees. These men, and the many others selected from various operating units of Anaconda, became or were loyal company employees. After all, in looking for a mine, you want men that have had some experience with geology as it's exposed in a mining operation, and know how to use that sort of data, can work well with mine operators, and provide an engineering approach to problems. I didn't want just plain theorists. I respected geological theory and scientific applications to mining problems. But for practical mine work, where it comes to the dollars and cents of applying geology to mining, you have to have, basically, an engineer's approach.

Swent: What about your relations with universities? Did you maintain contact with them?

Perry: We maintained contact with the University of California, for example, and with Stanford; also with the University of Arizona and the University of New Mexico.

Swent: Did you have professors coming around?

Perry: Yes. Particularly because of the new developments at Cananea, we were entertaining professors quite often. I had L. C. Graton as a guest at Cananea for several days.

Swent: From Harvard.

Perry: Graton from Harvard. I had Bateman there, and B. S. Butler from the University of Arizona. There were others of that caliber that were interested and wanted to see Cananea. We were always anxious to show them all the new geology and discuss ideas.

One of the interesting things about Graton was that in 1907 he was a young man on the team recruited by Dr. Louis Ricketts to make a geological study of the Cananea District. That was before any interest in the large low-grade porphyry copper deposits of the Southwest had been generated and long before the discovery of La Colorada ore body. Graton, with S. F. Emmons, made a geological map of the district. One of the features shown on that map was a very extensive area of what was called the Henrietta Diorite.

Diorite, of course, is a deep-seated intrusive rock, and in our early studies, the so-called "diorite" came under critical examination. We had just employed an experienced petrographer, Wilbur Valentine, from Columbia University and I asked him to remap the district with special emphasis on the Henrietta Diorite. He found that it was all volcanic, that it was lying unconformably upon the older sedimentary sequence, and that this identification as an extrusive rather than an intrusive rock type made a world of difference in the whole pattern of the Cananea District.

So when Graton visited Cananea, we took him in to the field and showed him his original map together with the revisions we had made. As Graton examined numerous outcrops he had little to say. When he came back to the house, my wife had him to lunch. Sitting around the lunch table, I said, "Tell me, now, what do you think about that diorite?"

He said, "Vin, I'll tell you. I was an awfully young man when I made that map." [laughter] So he admitted, in a very nice, gentlemanly way, that he was wrong. I found Graton to be a very helpful and understanding geologist and a great man in the field. I spent several days with him, and he came up with a lot of good

thoughts and ideas about Cananea geology, so that this was just something we could laugh over.

Swent: In choosing assistants, then, if it was a good student of Graton's, you would have been--

Perry: Yes, I was always impressed with that. I thought that Graton offered excellent courses at Harvard. Of course, I had always--back in my student days at Berkeley--been impressed with Don McLaughlin, and McLaughlin was Graton's principal star. Graton had been McLaughlin's mentor. So I felt that anybody that came from Harvard, if he had the right attitude and was willing to work, why we could use him.

Swent: Did you consider their wives at all?

Perry: Oh, yes, we did, definitely. That was one of the reasons I was partial to Anaconda men, because I knew their wives and families. I knew the kind of people they were and how they would adjust to mining camp life. It was very important.

My assistant, Mulchay, was an unusual man, and I picked him right at the start when I went to Cananea because I had great respect for his intelligence and for the work that he was doing in Butte. At that time, he was a bachelor but he was going with a lovely girl who was then attending the University of Montana at Missoula. I decided that Mulchay would be a fine man to support me in my efforts at Cananea. I never regretted that. Mulchay always served me loyally and with a great deal of intelligence. He was never a "yes" man. We had many arguments. In fact, there were times when Mulchay and I were at complete opposite ends of the pole.

Swent: About geology?

Perry: About various subjects. But I felt that a man that had not only the courage but the ability to stand up and fight for his point is a man worth having around. I remember one time, in desperation, saying to Mulchay, "The trouble with you, Mul, is that you're so terribly prejudiced."

"Now," he said, "tell me what's wrong with a good, solid, well-founded prejudice?" [laughter]

Mulchay was always willing to do the roughest, toughest kind of work on those field examinations down in southern Sonora. Lots of times, conditions were pretty tough down there. We had to have our own camps, and we had to carry our own provisions. We had to make arrangements for transportation, sometimes on horseback or

muleback. Mulchay was a great fellow to organize a trip and have adequate provisions for the job.

He would tackle things requiring skill and ability, such as shoring up the collar of an old shaft or putting in a ladder for access. He knew how to get in there and do a job himself. He wouldn't send one of the Mexican samplers down to test his work. Mulchay always went down and gave the windlass, or whatever device or ladder that had been constructed to do the job, a test with his own arms and legs before he asked any of his helpers to use them.

McDonald, again, was this same type man. Tremendous courage, ability, and loyalty--the kind of man you just liked to be around and work with. One of my great losses was the fact that after a very few years in Salt Lake City, I noticed his health began to fail. We had made a trip to San Francisco to a Mining Congress meeting. I had flown down, and Alex had driven his car from Salt Lake City. I thought Alex looked very poorly at the meeting. He wasn't the type to do any complaining about his ill health or anything of that kind. He had always prided himself on his strength and ability to get around and do the tough job.

"Vin," he said, "would you mind if I flew back to Salt Lake City and you drive my car back?"

I said, "No, Alex, I'd be glad to do that."

I wanted to stop, anyway, to look at a property near Ely, so I went back in his car, and while I was in Ely one night my wife called and said, "Vin, you'd better get back to Salt Lake City as fast as you can. Alex is not well." So I went back the next morning, and I found Alex in the hospital. He died a few days later from Hodgkin's disease. It was that quick. So I lost a great assistant there.

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Swent: Who became your assistant after that?

Perry: Well, about that time, I moved from Salt Lake City to New York. I asked Roland Mulchay, who had been my assistant at Cananea and who had been relocated in Tucson as head of our exploration work in the Southwest, to take over my position at Salt Lake City with the title of assistant chief geologist. Then I had the problem of getting an assistant eventually in New York, and that brought me into a whole new area involving the international activities. Ananconda was engaged in throughout Latin America and in Canada.

Swent: We haven't gotten into the Latin American things at all.

Perry: No, not at all. This might be a good time to do it.

Swent: Well, I wanted to ask a couple more questions about Yerington.

Perry: All right.

Swent: Did you run into any opposition from these farmers whose lovely farms you were --

Perry: Well, we didn't hurt the farms. McDonald was an excellent public relations representative for the company. During the time when he was doing the shaft sinking, he made many friends around Yerington. They respected him and the local people looked with favor on Ananconda's activities in this farming area, which was kind of a new twist, because you don't find that very often. But McDonald had qualities people liked and admired. His wife was a very friendly person, and she knew the wives of different ranchers and farmers around the Yerington Valley area. Through their efforts, the company had a fine relationship with the community.

Swent: They didn't mind your lowering the water table?

Perry: No, we didn't hurt the water table. The flow of the Walker River was so great that local pumping only lowered a water cone around the mine area. When the early underground exploration was being done, any letup in pumping would have flooded the workings.

As a matter of fact, there's an interesting story about that. After we had practically finished the preliminary underground exploration, I made a trip to get a last good look at what had been exposed in the most advanced crosscuts. There was one particular place where we had intersected a wide zone of chalcopyrite stringers that averaged 2 percent copper, and I wanted to see how persistent they were and whether they were unduly influencing the weight we had put on assays in that general area. So, with McDonald, we went down in the skip and got off on the two hundred level. I had my notebook and tape, and went back there and was carefully mapping these tiny veinlets of chalcopyrite. Alex McDonald, who, of course, knew that there was a risk because of the water, had stayed at the shaft to see that the skip was available to get out if we had to get out in a hurry. He came rushing back into this crosscut saying, "Vin, we'd better get out. The pumps are overloaded and the water is gaining on them." Sure enough, by the time we reached the shaft, the water was up to our chests. We climbed into the skip and were hoisted to the surface. There had been an unusual surge of water typical of this real wet, saturated country.

That water was never really controlled until the pit itself was opened up. The succeeding general manager, Millar, put in a lot of pumps around the periphery of the pit itself, and he was pumping on a grander scale than had been done while sinking the exploration shaft. That water was dumped back into the Walker River and the return of the water to the drainage system was welcomed by the farmers. So water was, really, an asset rather than a liability, as long as it could be handled.

Swent: And you weren't smelting?

Perry: There was no smelting. The concentrates were shipped to Anaconda, Montana, and the only copper produced at Yerington was from the oxide plant. We had an oxide plant that produced copper sulfate in solution. It was an oxide leaching process and the copper was precipitated electrolytically.

Swent: So this wouldn't upset the community.

Perry: No, no. There was no pollution of any kind involved there.

Our only difficulty with any of the farmers was when we came to negotiate to get some of their land for dumps and tailings disposal or for exploration. They were pretty smart Italian farmers, and they didn't give the big company any kind of a bargain. Of course, you couldn't blame them. [chuckles] But there was some land that we simply couldn't get hold of, because the prices were too high.

Swent: You weren't actually mining on what had been farms?

Perry: Oh, no. The alluvial gravel, you see, was not farmland. The farmland was in the river bottom, where the soil had accumulated. But there were places where we needed ground for tailings disposal, where we had to reach out into some of this area that was usually sagebrush covered, but it was land that had probably little agricultural value. The land needed and used for waste disposal wasn't first-class agricultural land.

Of course, I've felt that there's still copper to be found in the Yerington area. Much of that country remains under cover, a lot of it under very difficult cover. Some of it is covered by hard volcanic rocks, difficult to drill through because the rocks often are vuggy and are not particularly easy on a diamond drill bit. We did a lot of exploration, and we had some attractive showings. But with the change in recent years in the ownership of Anaconda's assets, Atlantic Richfield apparently was not anxious to tackle that sort of a job and the ground has been disposed of. I don't know who has it now. If it had remained under Anaconda

ownership and management, it would certainly have had additional exploration and development.

World War II and Its Effects

Swent: I believe you said that you were at Yerington when you heard of Pearl Harbor?

Perry: No, on December 7th, the Pearl Harbor incident was reported on a Sunday afternoon after I had spent the day underground mapping the geology of the old Shoshone Mine near Death Valley. I came up that night to get my evening meal, and sitting down at the boarding house table, seeing the looks of excitement on the faces of those miners, I asked, "What's happened?"

Somebody said, "Haven't you heard the news?"

I said, "No, I've been underground all day."

"Well, the radio has been full of it. Pearl Harbor has been attacked and destroyed, the U. S. fleet destroyed."

I drove down to Furnace Creek in Death Valley to a pay phone and put in a call to Margaret in Salt Lake City, asking her what she knew about the story I was getting out in this isolated mining camp. She said, "Every bit of it is true." I said, "Well, I'll be back tomorrow morning," and I started driving that evening and drove through to Salt Lake City.

Swent: What changes did it mean in your professional life?

Perry: I thought I'd better get in the service. Then I began to think of my age, and I suggested this to Weed. He said, "Absolutely not. You're going to be of much more use to the country doing this work with Anaconda and trying to develop copper for the war effort. You'd better stay right where you are." After thinking it over for a few days, I decided to do that, although my brother and I had quite a discussion on the subject. He volunteered for the Navy and received a commission because of previous training and experience. He was captain of a mine sweeper out here off the California coast. Of course, at that time we figured we were going to be invaded at any time.

Swent: Where was your brother living at that time?

Perry: He was living in Los Angeles. While this indecision about entering the service was going on, I went down to see him. He had a home in Santa Monica, and about two o'clock in the morning we were awakened by explosions. The sky was ablaze with light and flames and flashes, and the story was coming in over the radio that the Japanese fleet was off San Pedro and we were being invaded. We all got up, went out in the street to see this scene and were certainly awestruck by what was happening, just as all our neighbors were. We came back, and I remember the fear and panic that had engulfed all of us. My sister-in-law, Frank's wife, and their four little children, my brother and I all got into the same bed for mutual warmth and protection. We were all shivering. [laughs]

Swent: Terrified, I'm sure.

Perry: Terrified. The next morning, I woke to find The Los Angeles Times somewhat sheepishly admitting that everybody had been hoodwinked, that this had been a show put on by the U. S. Army off Palo Verde to awake the general public in Los Angeles to the fact that the war was on. There was no basis for it at all. Yet The Los Angeles Examiner had carried a story saying that "Japanese plane reported to have been shot down at Figueroa" and some intersecting street in Los Angeles. [laughs]

Swent: I never heard that.

Perry: Well, that's true. That happened in Los Angeles, sure.

Swent: The army had just--

Perry: The army had faked it to arouse the people to the fact that a war was on. A lot of people were pretty much unaware of the importance of the Pearl Harbor event. Probably word had gone out from the administration in Washington to do anything that would stir up public hostility to what the Japanese had done.

It was shortly after that they started rounding up all the Japanese here in California and putting them in detention camps. These were all things that I think were probably motivated by certain people in the administration in Washington to stir up war hysteria.

I know there was no question about my brother's attitude. He was enlisting the next morning to get out and man a mine sweeper to protect the California coast.

The Importance of Chilean Copper

Perry: But I went back to Salt Lake City and I didn't go into the service. I felt that I was doing something useful, and I think probably it was a wise decision. Later, I made a trip to Chile and could see firsthand the role that Chile was playing in the war. Copper was absolutely indispensable to carrying on the kind of things that were necessary, in manufacturing and shipbuilding and all the war production items that made American industry a critical factor in turning the war in favor of the Allies. I think the Roosevelt administration saw this, and I think they probably had it figured out about right. It contributed to the early end of the war culminating with the use of the atomic bomb. Those are terrible things, but that's what war results in--terrible things that we hate to face in peacetime but are there when the situation deteriorates into a war for survival.

Swent: You said you first went to Chile in 1944.

Perry: Yes, I made my first trip to Chile in 1944. It was under war regulations.

Swent: How did you get there?

Perry: We went by train to Florida.

Swent: Who's "we"?

Perry: Reno Sales and myself. We took the old China Clipper out of Florida. It was my first experience with an international flying trip. The old China Clipper was blacked out entirely and it made its run down Biscayne Bay in absolute darkness. I wondered how in the world it was going to miss all of the little ships and yachts and motorboats that I had seen scattered around the bay that afternoon. It took, it seemed to me, at least half an hour for it to get airlifted. It just chugged on and on through that water trying to get enough momentum to become airborne. Finally, it was in the air. We were seated in bucket seats in a baggage area, and there were probably about twenty or thirty passengers, most of them in one way or another participating in some war work and trying to get to South America. We landed at Panama and spent that day around the canal, stayed at the old Tivoli Hotel, which at night was blacked out. We were told to be dressed and ready at three o'clock in the morning to take a plane to Ecuador. We had tiny little flashlights that we used to dress and assemble our baggage and took off in a DC-2 to Guayaquil and then flew by short jumps to Lima. There were probably four or five stops along the coast getting to Lima, and then, after a day of layover in Lima, we

picked up the flight and went to Arequipa, then to Arica, Iquique, and Antofagasta. From there we went by motor car to Barquito, the shipping port for Anaconda's large mine at Puertocitos.

At Barquito, we were entertained by Walter Saunders and his lovely wife, Anne. Walter was the company representative and engineer there. He was also in charge of the newly-built railroad up to the Potrerillos Mine. The last leg of the journey was by track car from Barquito to the mine. Our assignment was to make a thorough estimate of available reserves and select those ore reserve blocks that possibly could be brought into the picture at an earlier date to enhance copper production.

Swent: It was already in production.

Perry: It was in production, yes.

Swent: And Chuqui also.

Perry: And Chuqui was also in production.

Swent: Chuqui was older.

Perry: Chuqui was older, yes. One of the purposes of our trip was to study the geology at both properties to determine whether production could be increased by exploiting additional ore. For the near term, it was evident that 100 percent of the effort should be concentrated on getting production out just as fast as possible. For the long term, Potrerillos was going to need more ore.

Discovering Indio Muerto (El Salvador)

Perry: At that time, Walter March was chief geologist at Potrerillos. He was one of the men from Butte who had been sent down there by Reno Sales several years earlier to organize a geological department. He had done some regional mapping and had ideas about geological possibilities in the surrounding region. So, one Sunday we took a picnic lunch and went out north of Potrerillos about fifteen or twenty miles, to a place called the Camp Area. The Camp Area had a very juicy-looking show of chrysocolla outcropping at the surface, but it was a limited sort of thing. You could see the outcrops around, and how restricted this good mineralization seemed to be.

However, while we were eating lunch, looking around the general area where there were uninterrupted views, I was impressed with a reddish peak behind our picnic spot. I thought that just as

a way of maybe aiding my digestion it would be worthwhile to walk over in that general direction and see what the red peak really looked like close at hand. So I started over there either alone or with one of the others in the party, I don't remember, and got over there in an hour or so and started picking around. I was very much impressed with the nature of the alteration and the fact that there were those same, little tiny quartz veinlets that had intrigued me when I started mapping over the great La Colorada ore body at Cananea. After returning, I asked Walter March about this area. He confirmed that he had been over there and had done some reconnoitering, and said, "Yes, there's probably a prospect there. But it looks like a very long-range sort of thing and not the kind of prospect we want to tackle right now. At least, the management doesn't want to do it."

We came back and talked to the general manager, Mr. Greniger, who said, "I know there's a prospect over there. As a matter of fact, the company already owns it. I've seen that that ground was covered with claims, but we're not going to go over there and explore. We have our hands full with our operation." So I was a bit disappointed that nobody saw anything attractive for the immediate future in Indio Muerto Peak, which is what it was called. I had that very much in mind when I came back to the United States.

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Perry: About a year later, thinking about my observations at Indio Muerto, I decided this would be a good time to do a more thorough job on what had appeared to be a first-class prospect. So I asked Roland Mulchay and E. C. Stephens, who was one of our Anaconda geologists and a University of California graduate, to make a trip down to Chile and learn something about Chuqui--just educate themselves on what a great mine really looked like. And while they were there, to visit Potrerillos and any other prospects in the area including Indio Muerto Peak. They were also to examine prospects on which the Santiago office had information.

So Mulchay and Stephens made the trip to Chile. They saw the different properties, including Indio Muerto, and made a geological map of it. They wrote a report describing the area and expressed their opinion that the way to work there was to start in on the so-called Camp Area where we had had the picnic on our 1944 trip and where there was good oxide copper sticking out of the ground and use the old "Cousin Jack" principle of following the ore to see where it led.

The report left me uncertain about how to tackle exploration of the Indio Muerto prospect. So, my next trip to Chile, I made a point of going up there myself. I climbed the peak and as I



Aerial view of Indio Muerto Mt. looking northeast into Granite Gulch. Concentration and other plant facilities in the foreground. 1960.

Photograph from Mining Engineering, April 1960.

approached the summit, I looked down and, believe it or not, I saw a rusty old hobnail. [chuckles] I knew that Mulchay had been there, because he was one of the few geologists that insisted on using hobnails. [laughter] So there was no denying the fact that he had given his best effort to studying the prospect. Anyway, I did some more mapping on my own. At that time, William Swayne had been moved down from Butte to take over exploration work for Anaconda in Chile. He was headquartered at Santiago, where he was independent of the local mine operations at Chuquicamata and Puertocitos. At this time he joined me in the field and, in the following months, he and his associates did geological mapping at Indio Muerto.

A fine detailed map was made of the whole area and sections drawn. Because of the steepness of the topography, it was fairly easy to get a three-dimensional perspective on the prospect. A drilling program was laid out. An early hole was at the Camp Area to test the strong copper oxide showing that had impressed Mulchay and Stephens. That hole cut an interesting section of copper. It was low-grade, but the hole was a thousand feet deep, and had copper values all the way down.

Swent: What sort of values were they?

Perry: Well, they were values in the range of eight-tenths to 1 percent copper. Measured against the kind of grades typical of Potrerillos and Chuquicamata, they were not considered ore. They would have been of economic value at Yerington or in Arizona, but not down there.

So we decided we had to do more drilling. Well, we fooled around with three more holes. One of them was a blank, and two more had some teasing values. Finally, Swayne said, "Let's just take the bull by the horns and jam a hole into the spot that has the best of the quartz veinlets and alteration." We drilled hole five, and I received a cable from Chile a short time after that saying, "Have cut wide section that averages 2 percent copper."

So that started us on the Indio Muerto project, and Mr. Glover, who was then chief executive officer of Anaconda, said, "You know, Vin, Indio Muerto [dead indian] is a depressing sort of name. Let's change it to something that has a more affirmative sound. Why don't we call it El Salvador [the savior]? It may

V. D. Perry, "History of El Salvador Development," AIME, Mining Engineering, April 1960.

William H. Swayne and Frank Trask, Geology of El Salvador, AIME, Mining Engineering April 1960.

really save us down there." [laughs] So it was rechristened "El Salvador", and the company went right ahead with the project, drilled the whole area out, spent a sizeable amount of money, and built a modern concentrator with a new town site. The ore reserve contained a proved 365 million tons of 1.65 percent copper. That, even in Chile, was considered a pretty good mine.'

Unfortunately, it couldn't be open-pitted. The thickness of the capping and the contour of the peak made it impractical to mine by surface methods. The stripping ratio would have been much too high. So Brinckerhoff, with his experience in block caving at Inspiration and Potrerillos, designed a block caving plan with a tunnel entry, which made it very easy to get in and access the whole area of best-grade material. He was in charge of getting the project underway and did it in a fairly short time so that by the late fifties the company was in production at El Salvador. It proved to be a very valuable Anaconda mine for the next ten years until expropriation occurred. [pause] That was really a major exploration in Chile, although a lot of successful exploration was done out of Chuquicamata in later years.

While geological studies in Chile were underway, we were also working in British Guyana. Jack Knaebel, Glenn Waterman, and others were located there but when that work ended Glenn was brought over to Chuquicamata. He was an exceptionally talented geologist and took excellent geological notes. At Chuquicamata he started on a detailed map of the Chuqui pit and also of a drain tunnel which was being driven under the pit to take care of the small amount of water which had begun to appear in the bottom of the pit but which was of no serious consequence to the operation. The tunnel was mainly of value to the geologists, because it exposed the downward extension of all the strong copper mineralization that was being mined in the pit.

As I believe we may have mentioned previously, when Reno Sales made his 1930 trip to Chuqui, he had suggested drilling some holes to find out what was underneath this fantastically rich copper oxide bonanza and the leached iron oxide capping adjacent to and paralleling the West Fissure. Sales drilled three holes under the leached capping. They showed good grade sulphide ore of sufficient lateral as well as vertical extent to demonstrate that a minimum of 200,000,000 tons of 2.75% copper existed under the west side of the open pit. Mr. Kelley used this information to convince the banks during the Depression that Anaconda was a good risk for additional loans.

*Lewis B. Gustafson, John P. Hunt, "The Porphyry Copper Deposit at El Salvador, Chile," Economic Geology Vol. 70 No.5 August 1975.

Waterman used the information from these holes and his mapping to make a series of maps that for the first time showed the structure, rock relations, alteration, mineralization, and distribution of metal values in the Chuquicamata ore body.

Prospecting in British Guyana and Brazil

[Interview 4: March 13, 1990]##

Swent: I think when we last were talking, we had just been talking about the Indio Muerto-El Salvador prospect in Chile. We hadn't talked much about Chuqui, but you wanted to go back and pick up British Guyana.

Perry: I think this would fit in with the general trend of the narration.

Swent: When was El Salvador developed?

Perry: The first trip was 1944, but no serious work was done there until the early fifties. That's when the actual exploration drilling was done. The mine was brought into production about 1956.

Swent: And Guyana was before that.

Perry: Guyana was before that. Guyana was in the late forties.

Swent: That was a different metal also.

Perry: That was a different metal. We were looking for gold, although we were looking for copper and other valuable nonferrous metals, too.

The reason for selecting British Guyana as a place for regional exploration was clear and compelling. In eastern Venezuela the Conquistadors of early days had found and exploited rich gold deposits close to the common border with British Guyana. The same favorable geological formations and structures continued across the international line. Early British colonists concentrated their endeavors on agriculture rather than on mining and developed sugar plantations along the coastal plain. The objective of looking for gold in a favorable geological environment and within the political boundaries of a stable British colony was attractive.

The venture was initiated by an individual from Vancouver who had contacts with the governing authorities in British Guyana. He

also knew Jack Knaebel and suggested to me that he would be an excellent man to organize and manage such an undertaking. The problem, of course, was to recruit some kind of an exploration organization that might effectively carry on that sort of a job. I knew Jack Knaebel personally in Salt Lake City. Jack was well known then for his mining engineering and operating ability. He had just finished an important job for the U. S. Smelting and Refining Company at Bayard, New Mexico, and had returned to Salt Lake City. He was considered Dick Hunt's right-hand man. Dick was the chief geologist of U. S. Smelting at that time. I approached Dick Hunt and talked it over with him, asking Dick whether he thought he could spare Jack Knaebel. Dick Hunt proved again his human interest and desire to help his men when he told me that he would never stand in the way of Jack Knaebel or anybody else in his organization if they had a better professional opportunity to do something unique and original, and said it was okay if I discussed a job offer with Jack Knaebel.

The net result was that Jack Knaebel was hired as an Anaconda engineer. He made necessary contracts with the British Guyanan government, recruited a staff of men, many of whom had been with him on earlier jobs, and proceeded with the project. The work there was started in Knaebel's inimitable style. He organized several camps in the jungle. These camps included living quarters for the men and for the wives of the staff and their children. In addition, he constructed an assay office, a sawmill, a power plant, and all the other necessary things that made for an efficient and yet not extravagant base of operations.

Swent: Had he done this sort of thing before, in other places?

Perry: Not on such a large scale, but he had been an engineer and operator in the Philippines before World War II, and had had some experience with foreign activities, particularly under jungle conditions. So this wasn't an entirely new undertaking for Jack.

Several prospects were carefully mapped. The geological work was under the able direction of Glenn Waterman. Likely showings were tested with shallow drill holes.

Swent: Showing of what?

Perry: Almost entirely gold. There was one prospect, particularly, that looked attractive and was drilled out. It was called the Omai prospect. It was an aplite intrusive which was laced with quartz veinlets that carried small amounts of free gold. The drilling indicated that there might be a large tonnage of low-grade material. Knaebel proceeded to sink a vertical shaft and did enough underground work to check the drill hole results and establish,

without much question, the accuracy of the grade and the extent of the ore body. Unfortunately, about this time, there were indications in the international markets that the price of gold was beginning to weaken and that there was uncertainty about the future of gold.

Swent: When was this?

Perry: It was about--let's see, the date would have been about 1949--or 1950. It was about four or five years after World War II.

Swent: And did you get down there? Were you down there?

Perry: Yes, I made trips there to check on the progress of the program. Incidentally, in connection with that, we did some reconnaissance work in adjoining areas of Brazil. One of the facilities that Jack had at his service was a company-owned two-engined Grumman Goose. This was a hydroplane which could land on the rivers and had a land base at Atkinson Field, which had been built by the U. S. Air Force during World War II as a primary staging field for the transport of planes across the South Atlantic to Africa. It had remained in operation as a commercial airport and was a convenient and useful facility for servicing the Anaconda plane.

Swent: Did you go down there before there was any exploration done? Did you get in on the negotiations with the government at all?

Perry: No, the negotiations were carried on by Knaebel and the resulting contracts were approved by me, the legal and mining departments. I made subsequent inspection trips, including one with Dick Newlin, then Mr. Weed's assistant in the mining department. We had the finest cooperation with the colonial government. It maintained an excellent geological survey, so they were of considerable help to us.

Swent: Did you take their word for things, or did you go out there?

Perry: We did our own geological work, but government maps and reports were available. It was very important to have reliable data on which to base further field investigation.

Swent: So you looked at their data first and then you went out and checked it?

Perry: Not necessarily. We often initiated our own field targets. But we certainly used what information was available.

Swent: Did you do this yourself? Were you out there tramping in the field?

Perry: The field work was done by Glenn Waterman and the local staff. I made trips there to see the progress of the work.

One trip in particular that I remember, was made with Jack Knaebel, Glenn Waterman, Don Johnson. We had a jeep, and the jeep broke down about thirty miles from the landing strip where we had left the Grumman Goose. We went ahead and made the examination of the prospect, sampled it, and left the jeep in the woods and walked back through the jungle. I'll tell you, it was a long, long walk. It was thirty-four miles through a lot of mud and slippery country. We finally got back to the plane just as a thunderstorm was breaking and were relieved to get airborne when we did. I remember that night I flew with the other men into the camp at Omai and then took off for Atkinson Field, landed there, had a few hours sleep, and caught a Pan American plane that was passing through Atkinson, landing in New York the next day. I remember my feet were so raw and blistered that I had a hard time walking off the plane. [laughs] That was quite an adventure.

Swent: I daresay, yes. You were lucky you made it!

Perry: I guess I was probably the most unprepared of the group. They had been in the jungle for a year or more, and I don't think they suffered as much as I did. They had already been toughened up to that sort of an existence. But coming out of New York, it was a little bit too much for my tender feet. [chuckles] The word "tenderfoot" could be appropriately applied in this case.

Swent: Was it mountainous?

Perry: It was rolling, hilly country, but not mountainous. There were no mountains such as we think of here in the western United States, but the topography was uneven enough so that there would be relief of several hundred feet. The worst part was walking through wet and sometimes very thick jungle vegetation, with few trails.

Swent: You weren't following the jeep road, then.

Perry: On the long walk I have just described, we followed the jeep road, if it could be called a road.

Swent: I suppose when we're talking about technological innovations, the jeep was a pretty important help, wasn't it?

Perry: Well, the jeep was useful there, that's true. The only trouble was that there was relatively little of that country that could be navigated even with a jeep.

The great thing was the plane. The plane was exceptionally useful because the jungle is laced with rivers, many of them large and subject to variations in their water levels from hour to hour, depending upon the rainfall. It was nice to have a plane to depend on for water landings. One of the trips that we took was across the jungle cover of the southern Amazon Basin, the plains country of the Mato Grosso, and landed first in Bel Horizonte and then in Rio. On that trip we were often in sight of water. There were many places where you could make a water landing, so that a hydroplane was an excellent way of transportation.

Swent: And Knaebel flew his own plane.

Perry: We had a licensed pilot for the Grumman Goose, an American, Harold Curtis, who had been recruited out of Long Island.

Swent: So this made things possible that you couldn't have done twenty years earlier.

Perry: I think that's true.

Economic conditions had deteriorated to the point where it began to look very uncertain for an economic venture in British Guyana, and the company finally reached a decision to terminate the work. We left one good property at Omai with a large tonnage of prospective ore. It has been reported that in the last three years a Canadian company made some sort of an arrangement with the present government of Guyana and is exploiting this deposit. So somebody gained by it, even though Anaconda footed a sizable bill for the job.

Uranium Reconnaissance and New Mexico Mines: Haystack Butte, Jackpile, Paguate

Perry: On the plus side, it tested a fine exploration operational group under Knaebel's leadership, and it was extremely timely that at that period I was back on the Colorado Plateau making some early reconnaissance trips to study the possibilities for locating uranium. Uranium was coming into its own as an important metal, not only as a source for the government in connection with nuclear armament, but also as a fuel for nuclear power. It was also fortuitous that Luther Cleveland, who at that time was the chief executive officer of the Santa Fe Railroad, had an informal meeting with Cornelius F. Kelley of the Anaconda Company and told him that an Indian prospector had located some high-grade uranium at a place

called Haystack Butte on Santa Fe land and wanted to know if Anaconda would have any interest in making an investigation.

Swent: So the overture, then, came from Santa Fe.

Perry: Yes, originally.

Swent: Do you know where? I mean, were they having lunch together in New York?

Perry: I suppose so. It was an informal get-together.

Swent: How did you find Haystack Butte?

Perry: If you are asking about who discovered Haystack Butte, it was an Indian prospector. It was on Santa Fe land, and the railroad company did the first exploration test pitting. I followed up with an investigation of the preliminary work. The question was whether the extent of the showing was sufficient to have some sort of economic value. Santa Fe under the supervision of their engineer, Mr. Evans, had already started some test pits. An agreement was reached between Anaconda and Santa Fe that we would have an option to make our own independent investigation of all the Santa Fe land that was available in the Grants, New Mexico, area. That was a considerable undertaking, because the Santa Fe owned alternate sections which had been granted to them by the U. S. Government when the original main line of the Santa Fe had been put through the Southwest. The investigation was started by Roland Mulchay and his assistants doing a thorough mapping and sampling of the Haystack prospect.

Swent: Where did you stay when you went out there? Did you camp out there?

Perry: No, we stayed at Grants.

Swent: You went in from Grants?

Perry: Yes, and drove back and forth from Grants. It was easy access, completely opposite from the type of thing that I had just experienced in my travels with Knaebel through the jungles of British Guyana and Brazil. [laughs]

##

Swent: I see. But at the time you first went to Haystack, Guyana was still being explored?

Perry: No, Guyana had been terminated by then.

Swent: Oh, it had.

Perry: Yes, Knaebel was closing the Guyana project, and the question was, where are we going to put this very able fellow to work on some other job that would fit his skills and abilities?

Swent: Okay. In a way, I got off on a side track, but I did want to get that.

So, at that time, luckily, the Haystack prospect came along, and you went down and looked at that.

Perry: I looked it over, but Mulchay did the detailed study and recommended that it should be put into production. The first move was to do enough bulk sampling to get material for mill tests, which were carried out at the Anaconda laboratory. A mill flow sheet was designed. Construction of the mill was started shortly.

Swent: Who built it? Did you do that yourself?

Perry: I believe it was built by Parsons Jurden Company. They did most of the construction work for Anaconda. The organization started out originally as an Anaconda engineering group in the town of Anaconda. Jurden was an Anaconda engineer but his group branched out into an independent construction firm after it had developed a very widespread clientele and a fine reputation. Other companies, such as Phelps Dodge at Morenci, wanted their services.

Swent: Did you have anything to do with that kind of decision?

Perry: No.

Swent: Or mill site? Did you choose that at all?

Perry: No, no. That was all up to the operators to decide where they wanted those things.

Swent: You simply did the analysis of the --

Perry: Of the ore body and recommended that the expenditure for that kind of a mill was justified, and that the arrangement with Santa Fe should be continued and further exploration done not only on the Todilto limestone, but the Morrison sandstone in the same general sedimentary section, which my information on the Colorado Plateau indicated was the most favorable host rock for uranium mineralization.

Swent: Did you go back to New York to defend your recommendation?

Perry: Yes, I made frequent trips back to New York to discuss these matters with New York officials. This is when we decided the uranium project would be an ideal place to use the initiative and skills of Jack Knaebel. Jack came out, and in true style, he immediately wanted an airplane. He and his staff began flights round the various clifflike rims of the Colorado Plateau, in that general New Mexico area, and in the course of those flights, using a scintillometer, detected anomalies that were strong and significant.

Swent: Did you go on any of these flights with him?

Perry: It was mostly done by Knaebel; I made a few flights with him. Some of this ground involved the Laguna tribal reservation, and Jack met with the Laguna tribe and made a very attractive deal with the Indians, which gave Anaconda exclusive rights to exploration on their tribal lands. There were provisions for payments of royalty and for hiring Indian labor and doing various constructive things in connection with the Laguna tribal communities.

Swent: Did you get in on any of those?

Perry: No, that was all Jack Knaebel's work, not mine. The net result of it all was the discovery of the Jackpile Mine and the opening up of a large open pit which soon put Anaconda in the position of major uranium mining producer in the United States.

Swent: Was the Haystack Mine an underground mine?

Perry: No, the Haystack Mine was a surface mine.

Swent: This was in the early fifties, yes.

Perry: Yes, in the early fifties. After the Jackpile discovery, the Paguate ore body was found. That was another large ore body. Knaebel also made some attractive deals with owners of various ranches in the area. There were some small discoveries made, but the main production was from the Jackpile and the Paguate. Both those ore bodies were approximately thirty miles from the Bluewater Mill which had been built fairly close to the Haystack mine, but they were both close to the main line of the Santa Fe Railroad, so it was a cheap railroad haul from mine to mill. The operations under Knaebel and later under Albert Fitch, made excellent costs, and were highly profitable undertakings.

Swent: Albert Fitch was the manager.

Perry: He was the manager. I don't remember the succession of titles, but he was generally second-in-command under Knaebel. Then it was shortly afterwards that we became interested in the area south of Tucson.

Swent: I just did want to say, I think it's kind of interesting, that development there at Haystack. You brought in people from all over the world. There were people from Chuqui and people from Guyana who came, and then --

Perry: Well, the staff was recruited from different operations where men were available that fitted particular jobs and had Knaebel's confidence and approval.

Swent: A very exciting time.

Perry: It was, yes. Jack Knaebel, because of the constructive work he had done on the New Mexico uranium operation, was wanted back in New York. The mining department of the Anaconda Company felt that it had a place for Jack as an administrator in the New York mining department. But New York was not a place where Jack Knaebel wanted to live. He was a mine operator and a very competent administrator, but he wanted to work out in the field and not behind a desk in a big city office. It happened that the geological department under Mulchay's supervision had started an aggressive program in Arizona south of Tucson at the old Twin Buttes District. We had gone far enough along so that I felt that it would be a very important place to use Jack's talents. We had already done enough drilling so we knew we had a sizeable ore body, but we didn't know how good it was. We needed confirmation by driving some underground work, so Jack was moved out of New York to Tucson and took over the job of managing the exploration work at Twin Buttes.

Swent: He had been in New York, then, for a while?

Perry: He had been in New York for a while, I don't remember how long.

Twin Buttes, Arizona

Swent: And Twin Buttes was copper again ?

Perry: Twin Buttes was copper, yes. The Twin Buttes story goes back a long ways, as far as Anaconda is concerned, because in 1935, Mulchay and I had gone out from Cananea on a mine examination north of the border. We had stumbled across these very interesting

outcrops on a mountainside a short walking distance away from the prospect that we had originally started out to examine. We tied that area up. It was the old Rosemont property. It was owned by the Lewisohn brothers who had been the original operators at the Miami Copper Company. We drilled three shallow holes. In testing the outcrops, we found considerable showings of copper, but they were not high enough grade to interest the mine operators in the Butte or New York office, so these claims were finally dropped.

However, we continued to feel there was something worthwhile in that whole general area, and, many years later, when United Geophysical came in and, using a magnetometer, located a small high-grade ore body near Mineral Hill, which was several miles from Rosemont, it revived our interest. Mulchay, who was then head of the exploration office in Tucson, proceeded to make an investigation.

Swent: You still held the claims?

Perry: We had given up the Rosemont claims, but in the meantime a small company in Salt Lake City called the Banner Company had acquired a large landholding in the district. Anaconda's then executive vice president, C. J. Parkinson, who was a Salt Lake City resident, knew some of the principals in the Banner Mining Company. Through his efforts, we were able to secure an option on all of the Banner holdings. These included ground adjacent to the discovery of the United Geophysical and also adjoining the American Smelting and Refining Company properties. They also included the Twin Buttes area, the Helvetia area, and Rosemont, all of them within several miles of the original discovery.

Swent: Now, you can go out and tramp around land that you don't have a claim on, but you can't dig holes in it, can you?

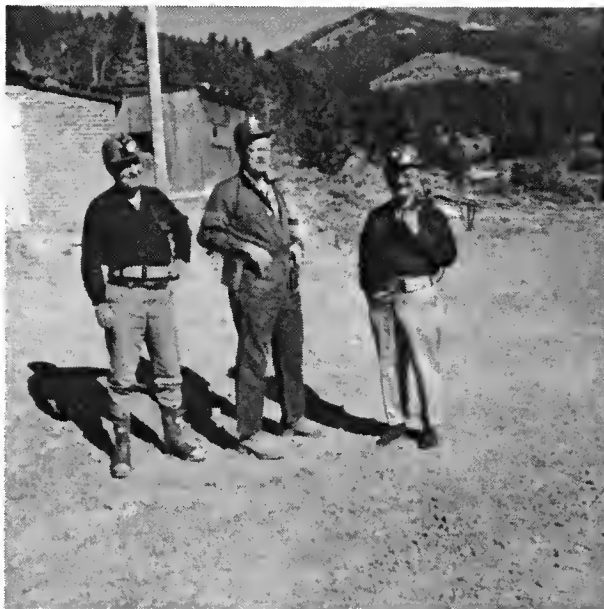
Perry: Oh, no. You have to have a land holding. You have to have a property right.

Swent: You can look at it.

Perry: Well, you can look at it, surely, unless somebody says, "No trespassing on my property," and makes a point of it, you'd better not. But, generally in the West, you're able to get around and see most of the land held in fee title or lease by ranchers. Much of it is government- or state-owned.

Swent: This is something you needed to know before you went in, didn't you?

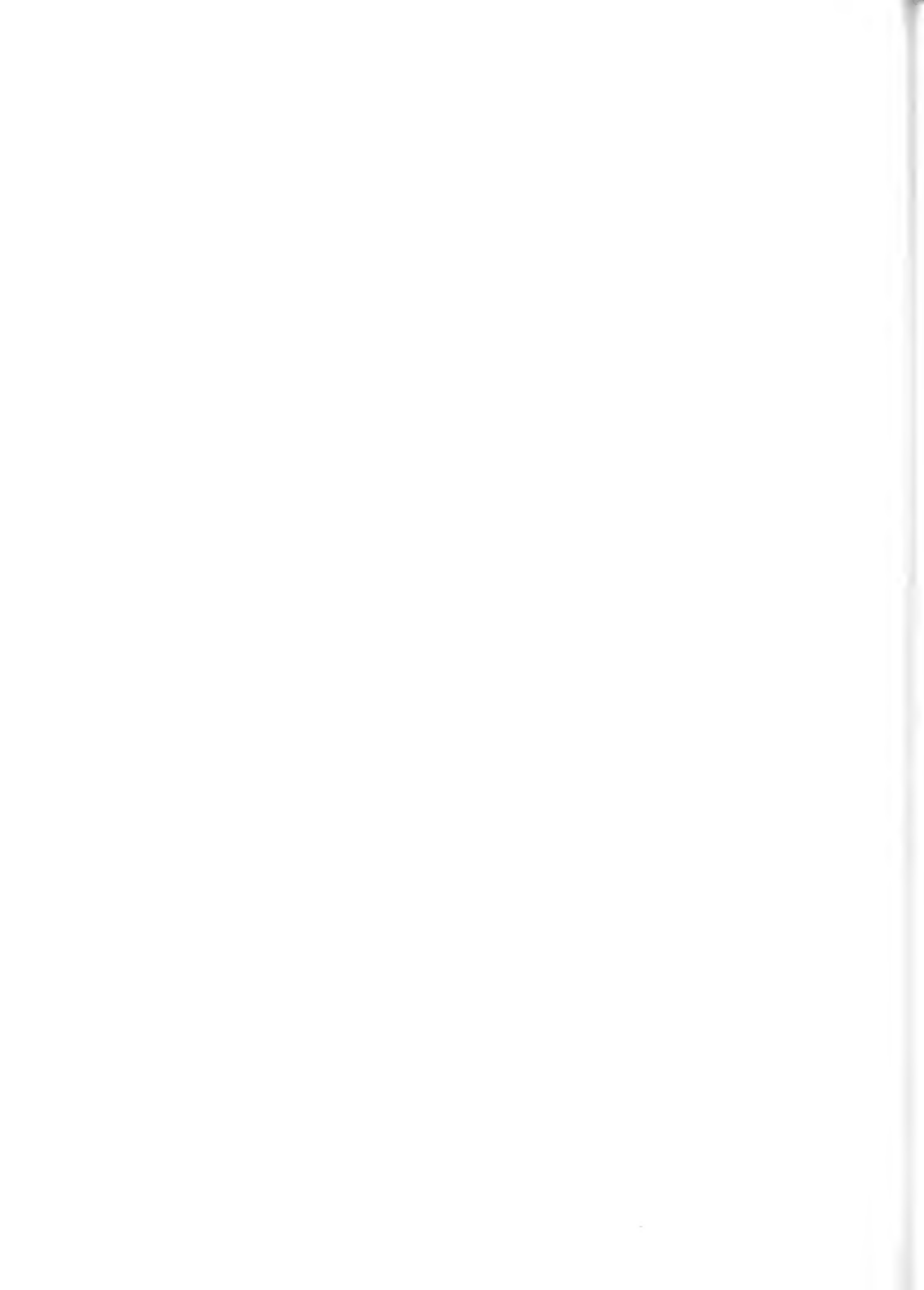
Elkhorn Mine, Jefferson County, Montana
October 10, 1970



Bob Tally, former manager United Verde Mine, Arizona, Bill Swayne, and Vincent Perry.



Vincent Perry climbing out of the main incline shaft of the Elkhorn Mine.



Perry: Well, I think probably we took it for granted, pretty much, that we could have access for geological study. In those days, the effort to keep people off private land was more restricted by cattle ranchers, for example, who wanted to be sure that no geologists came alone and opened a wired gate and left it down so the cattle would run away. That was the principal problem. We were good at always going through a gate and being sure that we locked it behind us, so that we were not interfering with the activities of whoever owned or was making use of the land.

Swent: I was just thinking, when you said in the thirties you were looking at something else, but then you checked out this other outcrop --

Perry: Yes, you are referring to the Rosemont prospect; we didn't have any idea of ownership. After we saw the outcrop and liked the looks of it, as I recall, Mulchay made a trip from Cananea back to Tucson, searched the records in the courthouse and found the property was privately owned. Contact was made with the owners and an option secured.

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Swent: So you could wander around, and you could chip off a few pieces of this and that without problems, but then when you say, "We drilled holes..."

Perry: Oh, we had to have a tie on the ground, definitely.

Swent: Then you had to bring somebody else in, a drill team.

Perry: Usually we had relations with different diamond drill contracting groups, and we arranged a drilling program.

Swent: That's a whole different thing.

Perry: A different thing, and one of the problems, likely as not, was to develop a water supply to use in diamond drilling. In that desert country south of Tucson, water was at a minimum. You had to develop a water supply, and a camp for the drillers and access roads. Such business was usually handled by the drill contractor.

Swent: It didn't just happen, though.

Perry: It didn't just happen, no.

Swent: You had to get authorization from New York?

Perry: Those things were always budgeted. We would get an allocation of money from New York to carry on the work.

Swent: And you could go ahead, with that authorization, on your own.

Perry: Yes, and spend the money as needed.

Swent: Did you ever get shot at by an irate rancher?

Perry: No. I think there was one case where Bob Lynn, who had been transferred from the Grants operation and was working, I believe, at that time in Utah, had a run-in with some claim owner who said that Lynn was trespassing on his ground. There was a little argument, but it didn't get to the point where they were shooting at each other. [chuckles]

Swent: You didn't have the hazards of marijuana growers down there in those days.

Perry: No, no. I think they're a lot more dangerous than adverse claim owners, generally, in the Western mining districts.

Swent: I understand that they are.

Perry: As a matter of fact, let us make a complete shift from the subject we were discussing. Several years ago, I heard about a gold prospect just south of Carmel. We drove down along the Big Sur Mountains with my sisters and another lady, and followed a road back into the hills. It was steep and mean grade. I heard a motorcycle coming around the bend just ahead of us, and a real tough-looking character challenged me and said, "What are you doing up here?" I didn't like his looks--I was concerned about the safety of the women--and I thought the best thing to do was to get out of that place, so we turned around and drove on back. We stopped at a recreation center just south of Big Sur, and I told the man in charge there about the challenge we had faced, and he said, "You're smart to get out of that place. They're growing marijuana up there, and they're a pretty tough bunch. We don't dare go up there." So I think the Coast Range of California, with all its beautiful scenic attractions, has a rough element within it that we hear little about, but it's there.

Swent: I think it's one of the hazards for field geologists, actually. It is one of the things they don't teach you in your geology course in school.

Perry: When we were going to Berkeley, we would certainly have gone up and looked at places like that, and I'm quite sure there would have been no difficulty in getting around. That was in the days before marijuana and other drugs were the "in" thing in a lot of our society.

Swent: So, the Twin Buttes prospect, then.

Perry: We went ahead with the --

Swent: -- ahead twenty years later.

Perry: -- with sinking the shaft, and Knaebel designed the open pit based upon both surface drill results and the underground work.

Many verticals were drilled. One hole in particular deserves special mention, I believe it was hole 665. It was drilled under the supervision of Jim Kelly, who was in charge of geological field work at Twin Buttes. The hole was located at the east end of the ore body where it is cut off by the East End Fault. It was approximately 5000 feet deep and averaged better than 1 percent copper for that great distance. A high-grade zinc zone was encountered. Surveys indicate the hole stayed on vertical course, but the interpretation of the geology is uncertain. There is a reasonable chance it cut the East End Fault and its deeper part may be in the faulted part of the Twin Buttes ore body. Further drilling will be needed to understand its geological importance.

Transferring A Property From Exploration To Operation

Swent: Were you still in charge of it at this time?

Perry: When the pit was designed, it became an operation, and I was not in charge of that. Operations was under the mining department, and Knaebel was reporting directly to the mining department.

Swent: Is there a definite point at which you're told that it's no longer yours?

Perry: I think it's usually quite evident where the cutoff is. As long as you're exploring and developing, where geology is the primary consideration, it's a function of the geological department. As soon as it reaches the stage where large sums of money must be expended to establish an actual operation, it is no longer a proper function of the geological department, although the geological department--just as it did in the mines of Butte, Montana, or as it did in the big open pits in South America--had a function as an operating adjunct to the mining department. The geologists in Butte, particularly, had a day-to-day function, because they located the required crosscuts and drifts whenever a vein is cut off by a fault, and the problem is to pick up the faulted extension

of the vein, usually a matter of crosscutting a few feet or maybe a few hundred feet. These development operations were all directed by the geologists.

The system, as it was developed by Anaconda, is to have a set of written recommendations. The geologist writes the recommendation, it's approved by the mine foreman or the mine superintendent or both, and the geologist supervises the direction of the work--how far the crosscut should be driven, when it should be stopped. All those decisions are geological decisions, even though they're carried out by the mine operator. This system has worked very well. It's a matter of coordination and cooperation between the mine operator and the mine geologist.

Swent: When you were promoted and took Sales's job in Salt Lake City, were you in charge of all geologists, then?

Perry: Yes.

Swent: In the mine in Butte as well as the exploration?

Perry: As well as the exploration and the mines in South America and any place where Anaconda had a mining operation.

Swent: So you hired them and supervised them both at the operations and in exploration.

Perry: Yes, that's right.

Swent: The geologist who's attached to an operation has a different job from the one that's in exploration.

Perry: Generally that's true, yes.

Decision On Open-Pit Or Underground Mining

Swent: Did you have anything to do with deciding, for example, that Twin Buttes or Haystack would be an open pit or an underground mine?

Perry: Yes. There was very definite input by the geological department in questions of that type. Sometimes there were some very strong opinions and prejudices involved, particularly on the part of the operators. [chuckles] They, of course, were always looking for the technique that would produce the lowest cost. Of course, there was nothing wrong with that. We were all interested in low cost, but the geologist had a longer-range viewpoint. He was considering

what might happen fifteen or twenty years later and how it would affect the operation for the long pull.

Chuquicamata, Chile

Swent: And what difference would that make?

Perry: Well, I think the best example is Chuquicamata, and we might discuss this in connection with the whole story of Chuquicamata, because, it involved a very important decision with political and economic as well as geologic factors.

My first trip to Chuquicamata was in 1944, and at that time the operation was strictly on oxide ore--rich, high-grade material which had been purchased from the Guggenheim interests in 1923 by Anaconda and was being mined by open pit methods. The only exploration or development work that had been done--of course, it was evident that there must be rich sulfide ore underneath this beautiful oxide showing--was the three-drillhole project that Sales had launched about 1930 on one of his early visits to Chuquicamata. Those three holes showed good sulfide ore, extensive both laterally and vertically under the oxide ore body and adjacent leached capping.

But this gets back to the subject of how for the long term you mine a great ore body like Chuqui. By 1952, I had made other trips to South America, and my good friend and classmate at Columbia, Charles Brinckerhoff, had been moved up to the position of general manager at Chuqui, so I found in him a very friendly and responsive person to discuss the problems of geology and mining. The discussion revolved around whether it was better to move at an early stage underground to get at a lot of this high-grade sulfide ore by underground block-cave mining. Brinckerhoff's position was, I believe, right from the start that it was better to maintain open-pit mining, even though for the short term there might be periods when the grades would not be as high and the returns from operations might not be as large as they would have been if more ground was opened up for mining. I favored going underground to exploit higher-grade ore.

Glenn Waterman was the chief geologist at Chuqui, and worked in collaboration with the operating staff making a thorough study of the detailed distribution of sulfides and oxides. In particular, he correlated the geology of the open pit with his detailed mapping of the underlying drainage tunnel. He drilled several holes, some

across the best-grade ore close to the West Fissure Zone, which controlled the better-grade copper mineralization. On the basis of those studies, it was decided that the pit design should prevail and that the Anaconda Company should continue with the program as it had been laid out earlier, postponing an underground operation indefinitely.

Swent: You say, "It was decided." Who decided?

Perry: It was decided, finally, by Clyde Weed, who was then in charge of mining operations for the Anaconda Company. But Weed was very much interested in the alternate proposal, and one of the things that influenced him was the political situation developing in Chile which suggested that Anaconda might not have a long period in which to continue mining this greatest ore deposit in the world. He felt, as I did, that it might be better to go underground and to mine not only high-grade from the oxide zone at the surface but high-grade from the sulfide zone below, to maximize the total production that could be obtained out of Chuquicamata before it was expropriated.

Brinckerhoff, on the other hand, was looking at it from the viewpoint of a professional mining engineer. He said there was only one thing that we could properly assume, and that was that we would continue to own the properties, and we should have an engineering plan that went ahead on sound mining principles. Applying these principles, an open pit fitted the existing situation.

Mining Engineers Should Head Mining Companies

Perry: It wasn't many years later that the company did lose its Chilean properties. It's a question whether Anaconda would have been better off going underground or staying exclusively with open pit mining. I think, looking at it in historical perspective, it was just as well that Brinckerhoff's advice was followed. The large capital investment required for an underground mine was saved. Some degree of selectivity for better-grade ore was achieved and excellent pound costs were made during those last few years before Chile confiscated the mine. Those are decisions that have to be made by the top mining men in the company, and that's why it's necessary to have mining men at the helm of a big mining corporation, in order to chart its course on the basis of sound engineering principles.

It gets back to the problems that Anaconda faced later on when the banks interfered--unlike the attitude they had in 1932, when they allowed the chief executive officer of Anaconda to continue a mining operation even in the face of financial losses. When the hard times of the seventies came along and the price of copper dropped, Anaconda was in debt because of the gigantic efforts it had been making to try to replace Chile production by bringing in the operation at Twin Buttes, and by trying to expand the bulk mining operations at Butte. It also faced the extremely burdensome costs of environmental protection, which had become necessary because of the environmental restrictions placed upon mining operations. All of those costs put the company severely in debt so that the banks were in a position to call the turn.

When, in due course, Weed and then Brinckerhoff had retired, there was a short period when C. J. Parkinson, former chief counsel, was in charge. Then the vice chairman of Chase Manhattan Bank, B. M. W. Place, who had been an outside director and active board member, was selected to be chief executive officer of Anaconda. His knowledge of mining was an extremely limited one, so he retained a consulting firm made up of bright young men who had graduated in business administration from some of our prestigious schools. They advised him what to do with the Anaconda operation, the net result of which was, in trying to cut the payroll, some of the ablest men in the company were fired or given early retirement. Some time later, the Atlantic Richfield Company made an aggressive effort to take over Anaconda. The banks, primarily interested in money, were receptive. The story is typical of the kind of thing that goes on today in our business world, where the "short cut to profits" philosophy prevails. Insufficient attention is paid to good management using sound technical methods, with a deep understanding of the human factors, principally loyalty and cooperative support from the workers, the technical staffs, and those who run the operations.

Swent: There was this theory that management was management, and it didn't matter whether you were managing a mine or a university.

Perry: Oh, but this is not true. You have to have some specialized knowledge, and, particularly, a lot of experience in a particular field in order to do a decent job. This shows up in the activities and the successes and failures of mining companies. It's illustrative of the kind of thing that we face all through our economy. The problems of leveraged buyouts and consolidations and takeovers that are the fashion in the financial world today are ignoring some of the basic tenets of good performance, particularly, sound technical control of the operation. Then the fundamental profit motive of capitalism has an opportunity to work. If you go ahead and use the outcome of the bottom line as the one

and only test of whether a thing has been successful or not the analysis is incomplete. The history of Anaconda is an excellent illustration of it.

In my student days at the University of California one of the first books that was recommended to us was Herbert Hoover's Principles of Mining. Herbert Hoover was an excellent, highly competent, and successful mining engineer. His little book, The Principles of Mining gave the whole story and showed how the specialized phases of mining relate to the overall outcome of a successful enterprise. He used those principles in Australia as a young mining engineer out of Stanford University. He was very successful in applying them, and they are the same principles that should apply today in operating any mining company, even one as large as Anaconda that was vertically integrated from mine to consumer. The mines were there, and there was an interrelationship between mining, metallurgy, fabrication, and selling the product to the public, that was all part of the great producing corporation. When the principles underlying those functions are not followed, trouble appears.

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Perry: Perhaps it's an overexaggeration to say that was the basic cause of the end for the Anaconda Company, but it certainly contributed to it, even though the cataclysm that occurred in the loss of all the rich Chilean mines started the disaster. I compare it, for example, with the experience we talked about earlier in this interview, the destruction of San Francisco. The earthquake was the thing that triggered the San Francisco disaster, just as the loss of the great Chilean mines triggered the destruction of Anaconda. But it was the actual series of events that followed the earthquake, the disastrous fires, that destroyed San Francisco, just as it was a series of related events that ultimately destroyed Anaconda. They're rather comparable.

Swent: That's interesting.

Perry: [pause] Let's see. Where do we want to go? [looking through notes] We've talked about Chuqui. We might say a few more words about the geological work at Chuquicamata, because I think it was interesting that so much was accomplished there in a relatively short time.

The Geology of Chuquicamata

Perry: The geological department, with Glenn Waterman as chief geologist, not only did a masterful job in helping out on the operation of the big open pit and the decision to concentrate on open pit techniques, but it also developed an important extension of the ore body called the North Pampa deposit. This extends five kilometers north of Chuquicamata on the same general trend of the porphyry intrusive that contains the rich ore in the parent mine.

In addition, to the south, a large ore body called the Exotica was developed. This was not primarily a discovery by the geological department. It was actually found by the metallurgists when they were doing some test drilling in the vicinity of the oxide plant. However, the geological implications of results obtained from those operating holes were used in projecting back towards the source of the ore, and a large oxide ore body was ultimately drilled out.

Another prospect is located in a gravel-covered area near the road between the Chuquicamata Mine and the town of Calama. A hole was drilled here, I believe it was Frank Trask's recommendation, to test an idea that a post-mineral strand of the West Fissure had cut off and displaced part of the main Chuquicamata ore body to the south. The hole intersected interesting enargite-chalcocite mineralization. No offset drilling was done to determine its extent. [Since this interview, Codelco, the Chilean mining company, drilled the prospect and reports the development of 190 million tons including 50 million tons of 2.5 percent copper. This may be a partial slice or a major faulted part of the main ore body.]

An important development north of Chuqui is at the El Abra deposit. This was an old district, had been known for many years but had never been drilled. Anaconda did enough drilling to indicate this is a large good-grade copper deposit, and it will no doubt be mined someday.

A large deposit several hundred kilometers north of Chuqui in the Collaquasi District was found at Quebrada Blanca. This was also drilled and in recent years, after Anaconda's exit from Chile, it has been further developed by John Hunt and associated interests. Several natural resource companies and the Chilean government have shown an interest in its exploitation.

Bill Swayne was in charge of the outside exploration projects and had strong support from the geological staff at Chuquicimata and El Salvador. In all of these jobs there were studies of the

important relationships between porphyry intrusions and copper mineralization, which have contributed a great deal to the general knowledge of copper geology. They were conducted by Waterman, Hunt, Gustafson, and others in conjunction with the research work done by Charles Meyer in the Butte research laboratory.

Swent: And, again, I think some of this exploration was done by airplane, wasn't it?

Perry: It was done mainly on foot, with access over rough roads by truck and other vehicles. We did a photographic study of the entire belt from the Peruvian border to south of Potrerillos and photographed in color the ground along the trend of the West Fissure.

Swent: Did you have to then hire people who had special knowledge of interpreting these?

Perry: No, we did our own interpreting, but we, of course, hired a contractor to do the flying.

Swent: And you didn't have to learn any new skills in doing that?

Perry: Our geologists were experienced in the interpretation of surface geology, and the aerial photographs gave additional perspective to their observations. They correlated features which had already been mapped or reexamined areas to check new ideas suggested by the regional views revealed on the aerial photographs. But the required detail work was done by careful field mapping, using jeeps or trucks to get to the interesting areas, and then traversing them on foot.

Results were obviously not perfect. The outcrop of La Escondida, the large rich copper ore body discovered in the past few years and now under development east of Antofagasta, was not identified. This suggests other targets may have been missed. Such an oversight as Escondida proved to be a blessing for Anaconda shareholders, because expensive development, which in the long run would have benefited only the expropriation appetite of the then Communist Chilean government, was not paid for by the company.

VI VIEW FROM THE BOARDROOM, 1965-1969

Swent: Now, by this time, were you living in New York?

Perry: Yes, we were living in New York. We had moved to New York in 1956, and I worked at the Anaconda office, 25 Broadway.

Swent: Where did you live?

Perry: Gracie Terrace in Manhattan overlooking the East River, a nice view. The air was relatively fresh and cool because it was carried on southerly winds that swept up the East River. We were happy there. The only disadvantage, according to my wife, was that it was very difficult to get taxicab service in that somewhat isolated part of Manhattan. So we finally moved over to Park Avenue, where we acquired an apartment. I'm living there at the present time.

Swent: I had a Long Island address for you also.

Perry: We bought a place out on Long Island at Westhampton Beach in order to get out of the city on weekends and enjoy the country. Since my retirement, I've spent a great deal of my time out there. I like to garden, and I like the ocean and the general environment, preferring it to the mad rush in the concrete canyons that are called New York City.

Swent: But you kept your Park Avenue apartment?

Perry: Kept the Park Avenue apartment, yes.

Swent: And your daughter lives...?

Perry: My daughter lives near me in New York City--just seven blocks away.

Swent: That's nice that you were able to keep your family near, anyway.

Perry: Yes. My daughter and son-in-law, Walt Zielinski, have a son and three daughters, all raised in New York City, and now scattered about the country. Jean, the third child, and her husband, Bruce

Monaco, live in New York City and have two daughters, so I am a great-grandfather.

Exploration in Australia, Canada, Jamaica

Swent: So, you were flying off to Australia.

Perry: We did considerable investigating in Australia but did not become involved in a major mining operation. We developed one mine, the Redross, south of Kalgoorlie in Western Australia. It was a nickel deposit and produced for a considerable time. I don't know whether it's still in operation or not.

Swent: Was this one that you acquired that somebody else had explored?

Perry: No, we did the initial exploration on it. Worked it from the outcrop. We did exploration on a low-grade nickel prospect north of Kalgoorlie, which showed rather extensive mineralization. The grades were, in my opinion, submarginal. It may be that with further development this could become a likely prospect. But, again, I have no information as to what has been done there recently.

Attractive gold prospects were located in Papua New Guinea, and the company drilled the Kidston property in Queensland, Australia. The Kidston deposit is localized within a large mineralized rhyolite intrusive with a ring shape and with a mineralized breccia core. Low-grade gold values occur scattered throughout a complex structural system. When this and other gold prospects were presented to the board, it was decided that Anaconda would not become involved in gold mining. The highly speculative price of gold was the basis for the decision.

The company was in the aluminum fabricating business, although a less important competitor compared to companies such as Alcoa, Alcan, Kaiser, and Reynolds. Glenn Waterman made several very important examinations of bauxite deposits in Northeast Australia and in the Darling Range south of Perth. He had previously made thorough examinations of bauxite occurrences in British Guyana and in French Guyana. It was frustrating that his splendid geological work was not followed up by further development. The company deliberated about these questions and decided otherwise. The raw material, alumina, required for the company's aluminum operation, continued to be obtained through arrangements with several alumina producers in Jamaica. Anaconda geologist Rudy Forhan did

geological work in Jamaica, establishing the extent of the ore reserves there.

In Canada, through Jack Knaebel's effort, the Britannia Mine north of Vancouver was acquired. It was an old mine and supposedly worked out, but additional work demonstrated that there were extensions of the ore. We operated a mill at Britannia and mined a relatively small tonnage. In eastern Canada, under Bill Swensen's supervision, we developed a property near Bathurst. Later it was acquired by other interests; I don't know whether it is being operated. At Thunder Bay, on the east shore of Lake Ontario, Swensen developed an interesting low-grade platinum-copper prospect. In western Ontario, the Nakina iron deposit was developed, and Jack Knaebel managed the development drilling. Thorough economic studies resulted in a decision to market the property and it was sold to Canadian steel interests.

Coordinating Field Investigations with Laboratory Analysis

Perry: I think one of the real contributions that the Anaconda geological department made to geology and the mining industry was the work it did in coordinating field investigations with laboratory studies. Sales was instrumental in starting this work. In the 1940s he enlisted the services of an outstanding young graduate student, Charles Meyer from Harvard University, to head up the Butte research laboratory. Meyer, in collaboration with Sales, wrote several landmark papers on rock alteration in Butte and also made other significant contributions to geological research. Later he became professor of geology at the University of California, Berkeley.

Other Butte research geologists who have served or are now serving with distinction in the academic field include George Brimhall, professor of geology at the University of California, Berkeley; John Guilbert at Arizona; Paul Cloke at Michigan; Lester Zeihen at Montana Tech. Ruben Velasco, former Cananea geologist, is a professor at the University of Sonora, Mexico. In the field of scientific and professional organizations, Art Barber, an Anaconda-trained geologist, and who was vice president exploration and geology during part of the Atlantic Richfield era of the late '70s and early '80s, served recently as president of the Society of Economic Geologists.

Swent: When you talk about geological research, what are you doing? Chemical analysis?

Perry: The work is much more complicated; chemical analyses are important, but microscopic studies are vital and closely integrated with field work. The microscope is extremely useful in identifying minerals and in establishing the relationships between the various mineral assemblages. Essentially, the laboratory is in the field and accurate, precisely recorded field observations are the single greatest factor in sound research.

Meyer was adept at this work, and his ideas reflected the teaching of Graton at Harvard plus the experience he gained working with Reno Sales and applying these particular research procedures to the field problems in the Butte mines and in other mines that were owned by Anaconda. For example, he made a trip with me to Chuquicamata and spent considerable time there working in the field with Glenn Waterman, studying the rocks and alteration associated with the Chuquicamata ore body. He had marvelous opportunities to observe and to collect sample material. All this material was shipped back to Butte; thin sections and polished surface sections were made of the individual specimens, and these were studied microscopically.

The Importance of Scientific Research

Perry: In doing it, Meyer came to some important conclusions which generally have been applied throughout the mining industry. There's been a voluminous outpouring of literature by various individuals who refer almost invariably to the basic work that was done in the Butte laboratory. Anaconda also maintained an excellent laboratory at El Salvador in Chile. John Hunt and Lew Gustafson, both Ph.D.s who had worked with Meyer, were in charge of that laboratory, and their publication of the geology of the El Salvador mine is a great contribution to the development of modern theory about genesis of porphyry coppers.

Swent: So they were going beyond just identifying them?

Perry: Oh, yes. They were involved in scientific studies to determine why these things happen and the processes involved in--you might say--the anatomy of an ore body. In turn, these studies might be applied in exploration work. In many ways, the study of an ore body is akin to the work a biologist does on the anatomy of a human being. The knowledge gained that way can be applied in geology just as it is in medicine.

Swent: Did you ever have to justify the expense of this laboratory?

Perry: Yes, of course, it was necessary to justify it.

Swent: Did you have any problems defending it?

Perry: Well, I found out that the board of directors of Anaconda--by that time, I was serving on the board--were extremely interested and willing to support scientific research. I never had any difficulty getting financial support for any laboratory or investigative procedure that I proposed. This was one useful reason for being on the board.

One of the other things that I was able to do that met with the approval of the directors was to bring some of our top men, such as Swayne, Meyer, Hunt, Gustafson, and others, to talk to the board about the nature of their research work, so that the people that were putting up the money understood what we were trying to do. Those talks were received with a great deal of interest and attention; they proved to be a useful way to get financial support.

Swent: How did your going on the board change your perception of the company, or did it change?

Perry: Well, it didn't change. Those members of the board, who were also company officers, were men I had known and had worked with at various times. There were outside directors, which was a little different story. That was one of the reasons I brought in some of the men of my department to address the board and show them the nature of our work, particularly the research end of it, so that they could appreciate we were doing things for the long term that were not going to produce any immediate dividend but that might be applicable at some later time in the actual exploration for ore deposits.

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VII THE LIQUIDATION OF ANACONDA

Swent: Did you find that the outside directors and the inside directors differed in their attitudes?

Perry: No, I found that there was a good deal of harmony on the board. I retired at the end of 1969--at that time, the company was approaching a critical period in the Chilean situation. I had no direct involvement with the problems that were faced after that, but they were extremely serious and difficult ones.

Disaster in Chile and Other Burdens

Perry: The Chile disaster was the thing, of course, that brought the troubled time to a head. Accompanying it in the late sixties and early seventies, Anaconda had to make large investments particularly in Butte by going to large-scale operations on low-grade ore, first block caving of the Kelley Mine and then the opening up of the Berkeley Pit. All of these added to the financial burden. The opening up of the Twin Buttes property cost a lot of money, and this was all compounded by the expenditures that were required to control water and air pollution. It really put the company in the hands of the bankers.

Swent: I have an article here about the development of the Berkeley Pit that was making headlines at that time. Let's see, this was in 1956, was it?

Perry: The first work on the pit was done at that time, but work was expanded intermittently over a long development period extending into the '70s.

Swent: Right, and it was a pretty exciting event at that time, the greatest expansion program in the history of Butte, planning to

increase production by 32,500 tons daily. That's the increase. It was just, at that time, an unbelievably large development.

Perry: Yes, it was a big development, and it cost a lot of money.

Swent: Seven million dollars for equipment alone.

Perry: Yes, and that was a small part of it. A lot of property had to be acquired, including surface rights which were needed to provide for expansion of stripping operations to expose the underlying mineable ore.

Swent: There were 250 feet of cover.

Perry: There was at least 250 feet of cover that had to be removed.

Swent: It was an enormously exciting thing that was going on then.

Perry: That is true, but unfortunately, these things and events meshed poorly with the world economic climate, because the oil crisis was starting about that time. The great increase in the price of oil added materially to the cost of operations.

Swent: Were you still on the board at that time?

Perry: I retired December 31, 1969, and after that I was a consultant through 1970 and part of 1971.

In August of 1973 there was a field meeting of the Society of Economic Geologists at Butte which was hosted by the geological department. A principal feature of the meeting was publication of a guidebook, organized by Dick Miller, then chief geologist at Butte, and containing numerous interesting papers on Butte geology, many of them written by members of the local staff. It was a continuation of studies reported in the Graton-Sales volume of AIME 1968* and which had been organized by Roland Mulchay. I served on a discussion panel, and at one of the meetings presented a short commentary on the district's copper resources.

*Charles Meyer, Ed Shea and staff, "Ore deposits at Butte, Montana" in Ore Deposits of the United States 1933-67. The Graton-Sales Volume, John D. Ridge, Editor, Vol. II, Published by AIME, New York, 1968.

Atlantic Richfield's Drilling Program

Perry: After the meeting, the Butte management asked me to be a consultant and help in the development of the deep low-grade mineralized zones that were becoming increasingly important in the eyes of everyone connected with Butte. The development work was planned and supervised by Dick Miller and the local staff. It was an underground drilling program which developed an extensive body of low-grade copper-molybdenum mineralization, of early, pre-vein, geological age, but clearly related to the main stage, high-grade vein ores that had been the source of the district's production. Many hundreds of millions of tons were proven and extensions, plus some promising possibilities of better grade, were indicated.

But the work was thwarted by adverse economic conditions during 1976-77. At that time Atlantic Richfield, like other oil companies, was profiting by the high price of oil and was flirting with the idea of getting into the copper business. Through banking and investment institutions, a takeover of Anaconda was negotiated and executed.

The oil company, while knowledgeable in the natural resource business, was not familiar with problems and complex operations of a fully-integrated mining company. Arco was obviously impressed with Butte but did not revive the promising underground program that had been interrupted in 1975. Instead it was replaced in 1979 with a drilling program from surface. Eleven holes, each ranging from 5000 to over 6000 feet, were drilled. Arco brought its expertise as an oil driller into the job. Excellent core recoveries were made, the holes surveyed accurately for position plus geophysical anomalies, and the geological mapping and interpretation of the cores was done by Charles Meyer, his assistant, Mark Reed, and other Anaconda-trained geologists. E. O. McAlister, head Anaconda geophysicist, and assistants interpreted geophysical data. Results clearly indicated continuity of the low-grade copper molybdenum occurrence many thousands of feet beyond the important tonnage revealed by the 1974-75 underground drilling, but they did nothing to define economic limits and metal contents of possible mineable ore that might exist in this enormous mineralized zone.

The result was obviously discouraging to Arco. In the oil business deep holes are drilled from surface to a favorable geological target. Success and failure are measured directly by what the holes show. In the mining business, the economic value of a tremendous tonnage of mineralized rock cannot be measured in the same easy way, particularly where the target is several thousand feet below the surface. In that case, details of the geology must

be exposed and correlated, as had been done by Anaconda in the 1974-75 underground project. In retrospect, emphasis should have been on this type of exploration rather than on widely spaced, speculative holes drilled for geological rather than economic objectives.

I do not mean by this that the deep holes represent a wasted effort. The information they revealed will be very important in the final analysis of the Butte copper resource. Careful and intelligent correlation of the deep hole information with all Butte's geological data is the way to analyze and verify the concept of an indefinitely immense mineralized deposit containing a future metal resource greatly exceeding the district's past production.

Swent: Is the information still available?

Perry: It's still available, and it's the basis upon which I make my forecast that someday Butte underground mining will be revived and, under sound engineering management, will again be a major producer of copper. I'm convinced that there is more copper left in Butte than has ever been mined, and when you look at the statistics that Butte has produced approximately twenty billion pounds of copper you have some measure of the magnitude of what is still left in the ground. But it's going to require the right timing, the right economic background, and certainly a fair contract with labor, and a sound management to develop a truly large and profitable operation. It will probably have to be done by block caving. The experience of the sixties and seventies, when block caving was conducted from the Kelley shaft, provided an excellent positive test of its feasibility. The deep drilling that Atlantic Richfield did shows that there will be extensions of the zones that were developed in the 1974-75 program and which will also be amenable to large-scale, low-cost mining. So the opportunity in Butte remains to produce a large volume of copper, in addition to very important byproducts, including molybdenum, zinc, and silver. Much of Butte's low-grade deposit isn't deep; it is relatively shallow. The incompletely explored mineral resource between the easterly limit of the Berkeley Pit and the westerly edge of the currently operating Continental Pit contains a tremendous tonnage within the reach of open-pit mining.

Swent: You said this information is available. Their drill cores are still there?

Perry: The drill cores are now in the hands of the present owners of the property. The drilling program terminated in 1983 and by 1985 Atlantic Richfield was in the process of liquidating Anaconda's assets. The expense of the big drilling program at Butte probably crystallized the decision that the oil company had had enough of the copper business. "For Sale" signs were put up everywhere and many valuable assets were practically given away.

Montana Resources: A Success Story

Perry: One of them was the deal that was made with a fellow named Dennis Washington, who was a successful construction contractor living in Missoula, Montana. Dennis Washington acquired the whole Butte district, plus all the mine equipment, plus a 50,000-ton-per-day concentrator, and property rights, not only in Butte, but also at the Anaconda plant site with its extensive real estate and extremely valuable water rights--all for the sum of seven million dollars.

Swent: What a bargain!

Perry: It was a bargain. The Butte community enlisted local and state officials to provide economic incentives for reviving the Butte District. Instead of scrapping plant and equipment for a quick profit, Washington was induced to complete property acquisition and plan a new operation. He's a good, sound operator, and the first thing he did was tell the union hierarchy who had been in Butte for many years, that they were through. The net result was that the miners and, I think, the miners' wives as much as anybody, who were anxious to have their husbands back on a mining payroll, decided to support Washington's plan to put Butte back into production. Washington recruited a group of independent miners, millmen, and craftsmen and set up a labor system which was eminently fair. He paid good hourly wages plus a very generous bonus based upon productivity. He was able to go to work in the Continental open pit, which had been opened by Anaconda, has made extremely low costs, and has shown a very substantial profit for his operation. He is operating today at a profit. To demonstrate how attractive this looked to the eyes of an important and conservative mining company, American Smelting and Refining recently paid Montana Resources, the company that Washington organized, \$100 million in cash to buy a 49 percent interest. [chuckles]

Swent: Those are the stories you love to hear, aren't they?

Perry: They are.

Swent: When Washington buys this, he also gets the maps and the drill cores?

Perry: He obtained all the maps and the drill cores--all the information. And he retained one of the best Anaconda geologists to serve as chief geologist.

Swent: And that was ...

Perry: George Burns. George had worked both as a mine geologist and as a research geologist under Charles Meyer, a very competent, able man who has done an excellent job for Montana Resources.

The manager of the current operation is Frank Gardner, who was an Anaconda mining engineer and operator. He has been responsible for the day-to-day activities at Montana Resources mine and mill. He has a work force that is a fraction of the work force Anaconda had in the last days of the Berkeley open-pit operation, and his pound costs and productivity are substantially better than anything Anaconda achieved. So it shows that if the job is not fouled up with bureaucracy, banks, oil companies, and greedy labor unions, you can make money mining. [laughter]

Swent: You talked about this bonus system. How do you measure a miner's productivity? By the number of feet they drilled, by the number of tons, or what?

Perry: I'm not sure how their program is set up, and I wouldn't want to speculate on that.

Swent: It's not your field.

Perry: But I know it's based on productivity and on profit and it's very popular with the men. In fact, bonuses paid this last year, in some cases, according to reports, have been greater than total wages earned. Just how the scale is developed and measured, I don't know.

Swent: This might be the place for me to bring in this story that I was told, that when Anaconda was expropriated in Peru at Cerro Verde, that one of the last things they did before turning over the property was to remove all of the markers from the drill cores so that they would be valueless. Is this customarily done?

Perry: No, that is not conventional procedure. In Peru, the company was faced with an extraordinary situation. It's like some of the things that happen during a war. They aren't things that are generally condoned by society, but they are done. When you hand over your watch to a thief, you aren't obligated to give it to him on a silver platter.

An example of how bad tax laws can create an abnormal response is reflected in Atlantic Richfield's abandonment of all the very fine pumping equipment which was made in part of non-corrosive stainless steel. This fine equipment was left in the shafts and

down in the deep levels of Butte to be flooded by the stopping of the pumps and the inundation of the mines.

Swent: Very similar, isn't it?

Perry: Somewhat similar in the sense that one will lead to another. I don't know what Atlantic Richfield's rationalization of this would be, but it would certainly fit in with the idea that our tax codes require that if you want to take a write-off on a loss, you have to have some proof that it's a final act and a complete and permanent loss of assets. Maybe that was one of the reasons for their action. This is just an opinion of mine. I don't know whether it's right or not. But those things happen in this world. Under our tax laws, a large corporation that wants to take a big tax write-off would be economically justified in taking such action.

Swent: It comes to when you make your decisions on the basis of the taxes, doesn't it?

Perry: That's right. Sure. But these are well out of the realm of geology, and I am not making statements with any proof of their accuracy. I simply say that there are very involved situations where, in desperation or because of bad laws, people and companies do things that they normally don't condone.

More On Uranium Mines

Swent: On a totally different tack, but a question that I also wanted to ask--which we had talked about briefly off the tape--to get back to the uranium business: When you first went into Haystack and Jackpile, were you aware of the hazards of radiation at that time?

Perry: Yes, I think we were aware of them. One of the things that appealed to us was the value, or preferential value, of developing ore that could be mined by surface methods, so that the miners would be working in the open air and not in confined underground workings where they would be subject to concentrations of radioactive air.

Swent: So this was still another new factor being introduced into your decisions?

Perry: Yes, that's right. Sure. I believe we did have a small underground operation. I'm not sure how that was done and how deep the ore was mined, but there was a little breccia pipe called the Woodrow Pipe, and it was very high-grade ore, largely pitchblende.

We had a small exploration shaft that went down some distance below the surface. Whether the ore was all mined underground, or whether it was opened up as a small pit, I can't recall.

##

Swent: That was in the same area?

Perry: Yes, that was fairly close to the Jackpile.

Swent: Did you ever find uranium up in Utah or Colorado?

Perry: Yes, we did, but nothing approaching the value or importance of the Grants occurrences, so we concentrated all our activities on Grants, where we had the mill and the big open-pit mines.

Swent: Okay. Well, that was [pause] I think, the last question that I have on my list.

Other Anaconda Mines in the West

Perry: There are several projects that we haven't mentioned that I might just list briefly. There was the drilling and development of the Hall molybdenum property north of Tonopah.

Swent: Were you involved in this personally?

Perry: Yes, and the actual work was done largely by one of our exploration geologists, Jim Wilson. It became an important producer of molybdenum. I don't know whether it's being operated today.

There were very important developments out of Salt Lake City during the thirties when the International Smelting and Refining Company smelter at Tooele was operating full blast. Ore was found in the Tintic District, a very high-grade gold ore body and also a rich lead-zinc deposit, both in the North Lily Mine.

In the forties and fifties, when the geological department was looking for feed for the Tooele smelter, work was done on a property near Darwin, California, which produced very high-grade lead and silver ore. A mill was built there, and the concentrates were shipped to the Tooele plant.

A high-grade, small gold-lead property was found near Death Valley in California, the Shoshone Mine. It also had a small mill. High-grade ore and concentrates were shipped to Tooele. These were

all incidental operations in which the geological department participated and they provided feed for the Tooele plant owned by Anaconda.

One other thing that was done close to Tooele was to explore the ground immediately adjoining the Bingham Pit. This ground was owned by Anaconda from the early days.

Swent: Not the Bingham Pit.

Perry: Not the Bingham Pit, no, but the land adjoining it. The claims were owned originally by independent mining companies in which Anaconda acquired working interests. They provided feed for the Tooele plant. We drilled the limestone sections adjacent to the porphyry intrusive of the Bingham ore body. Those limestone sections contained important tonnages of good-grade copper with substantial gold credit. A plant was built on the basis of the development but was shut down by Atlantic Richfield when it began liquidation of Anaconda's assets. The plant and mining property were sold. The mining claims were purchased by the successor to Kennecott, the British Petroleum Company, which then owned Bingham Canyon. Now Bingham Canyon is in the hands of RTZ, Rio Tinto Zinc, the largest mining company in the world, based in London. Kennecott did development on the same stratigraphic sequence of mineralized sediments under claims that they owned as part of the original Kennecott holdings and found the same kind of ore. Eventually the plan is to mine underground the entire ore zone developed separately by Anaconda and Kennecott.

There are a lot of miscellaneous things that come to mind over those many years that were, in my judgment, not as significant from the standpoint of work done or achievements as the ones we've elaborated on in more detail.

The Great Satisfaction of El Salvador

Swent: As you look back on it, what gave you the most satisfaction of the things that you've done?

Perry: Well, I think the most satisfaction actually came from the work that was done in El Salvador, Chile, starting with my first scouting trip over the outcrops, followed by the reconnaissance map made by Mulchay and Stephens. And it was the determination, persistence and skillful work of Bill Swayne and his crew that finally resulted in discovery of a great ore body.

It gave me satisfaction from the fact that one of my most loyal and capable men, Bill Swayne, directed the exploration personally and did all the hard, dirty work of getting supplies over to an isolated spot in the Atacama Desert and seeing that those drill holes were punched down. A lot of other men might have quit, but Bill stayed with it. I think he deserves a lot of credit for that development. I take satisfaction in the fact that I had enough faith and confidence in Bill Swayne to bring him down from Butte and get him started on this job. He was made of the same kind of mettle as Roland Mulchay, Jack Knaebel and Alex McDonald. They had the necessary qualities of leadership and the technical abilities to get things done. Those are the kind of men needed in the mining business. And you don't find them very often.

Swent: No. That Chile desert is a terribly inhospitable place, too.

Perry: Yes. Well, you think, how do you get water over there? Water is not available for drilling. It must be trucked long distances over practically non-existent roads.

Swent: Well, it must have been tremendously satisfying to have had that succeed.

Perry: That, to me, was a very satisfying job.

Swent: It must have been.

Perry: I took great satisfaction, too, in having brought Mulchay to Cananea, McDonald to Yerington, and Knaebel and his crew to British Guyana. Although Guyana didn't produce a mine, it developed a group of geologists and engineers who contributed to other Anaconda successes.

At Yerington, Bob Moehlman gets credit for spotting the discovery hole. Then Alex McDonald came on the scene--we talked about him previously. Alex was the kind of fellow that got a job done. Where there was doubt that the Walker River would flood us out and we couldn't have an open pit there, Alex had a strongly positive attitude and moved in enough pumping equipment, concentrating it on a small spot and sunk a shaft where pumping lowered the water cone far enough so levels could be opened up to test whether an ore body actually existed. The ore body did exist and was mined as an extremely profitable operation. The timing was perfect. It came when copper markets were strong, so Anaconda made a very handsome profit out of the Yerington open-pit mine. That was a real thrill, too.

Swent: Does it seem that we've wrapped it up?

Perry: Well, I kind of think so. If you have some suggestions, fine. I think I've covered about what I'd like to record. In particular, I've talked about the contributions of Anaconda geologists and engineers who worked with me. There are many other valuable assistants whose names did not come up in the course of this interview. I'm equally grateful to them and mighty proud to have had the loyalty and help of all my many fine associates.

Swent: We've covered a long and wonderful sequence of events here.

Perry: Well, it's been an interesting life. [chuckles]

Swent: Yes, indeed. I certainly have enjoyed this very much, and I thank you.

##

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